User Manual

Moseley PCL-6000

Doc. 602-13375-01

January 2008

WARRANTY

All equipment designed and manufactured by Moseley Associates, Inc., is warranted against defects in workmanship and material that develop under normal use within a period of (2) years from the date of original shipment, and is also warranted to meet any specifications represented in writing by Moseley Associates, Inc., so long as the purchaser is not in default under his contract of purchase and subject to the following additional conditions and limitations:

1. The sole responsibility of Moseley Associates, Inc., for any equipment not conforming to this Warranty shall be, at its option:

   A. to repair or replace such equipment or otherwise cause it to meet the represented specifications either at the purchaser's installation or upon the return thereof f.o.b. Santa Barbara, California, as directed by Moseley Associates, Inc.; or

   B. to accept the return thereof f.o.b. Santa Barbara, California, credit the purchaser's account for the unpaid portion, if any, of the purchase price, and refund to the purchaser, without interest, any portion of the purchase price theretofore paid; or

   C. to demonstrate that the equipment has no defect in workmanship or material and that it meets the represented specification, in which event all expenses reasonably incurred by Moseley Associates, Inc., in so demonstrating, including but not limited to costs of travel to and from the purchaser's installation, and subsistence, shall be paid by purchaser to Moseley Associates, Inc.

2. In case of any equipment thought to be defective, the purchaser shall promptly notify Moseley Associates, Inc., in writing, giving full particulars as to the defects. Upon receipt of such notice, Moseley Associates, Inc. will give instructions respecting the shipment of the equipment or such other manner as it elects to service this Warranty as above provided.

3. This Warranty extends only to the original purchaser and is not assignable or transferable, does not extend to any shipment which has been subjected to abuse, misuse, physical damage, alteration, operation under improper conditions or improper installation, use or maintenance, and does not extend to equipment or parts not manufactured by Moseley Associates, Inc., and such equipment and parts are subject to only adjustments as are available from the manufacturer thereof.

4. NO OTHER WARRANTIES, EXPRESS OR IMPLIED, SHALL BE APPLICABLE TO ANY EQUIPMENT SOLD BY MOSELEY ASSOCIATES, INC., AND NO REPRESENTATIVE OR OTHER PERSON IS AUTHORIZED BY MOSELEY ASSOCIATES, INC., TO ASSUME FOR IT ANY LIABILITY OR OBLIGATION WITH RESPECT TO THE CONDITION OR PERFORMANCE OF ANY EQUIPMENT SOLD BY IT, EXCEPT AS PROVIDED IN THIS WARRANTY. THIS WARRANTY PROVIDES FOR THE SOLE RIGHT AND REMEDY OF THE PURCHASER AND MOSELEY ASSOCIATES, INC. SHALL IN NO EVENT HAVE ANY LIABILITY FOR CONSEQUENTIAL DAMAGES OR FOR LOSS, DAMAGE OR EXPENSE DIRECTLY OR INDIRECTLY ARISING FROM THE USE OF EQUIPMENT PURCHASED FROM MOSELEY ASSOCIATES, INC.

FCC Notice

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Any external data or audio connection to this equipment must use shielded cables.

PCL6000 Manual Dwg # 602-13375-01**; Revision Levels:**

SECTION	**DWG**	**REV**	**ECO**	**REVISED/ RELEASED**
	602-13375-01	A		
1.3.3, 1.3.4, 1.4.1, 2.2.2, 4.2.1, 4.3.1, and 6	602-13375-01	B		January 2008

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Glossary

AFC	Automatic Frequency Control
AM	Amplitude Modulation
AGC	Automatic Gain Control
BB	Baseband
BCD	Binary Coded Decimal
BPF	Band Pass Filter
BW	Bandwidth
Comp	Composite
dB	Decibel
dBc	Decibel Relative to Carrier
dBm	Decibel Relative to 1 mW
DP	Decimal Point
DVM	Digital Voltmeter
EMI	Electromagnetic Interference
EPROM	Erasable Programmable Read-Only Memory
ESD	Electrostatic Discharge, Electrostatic Damage
FCC	Federal Communications Commission
FET	Field Effect Transistor
FM	Frequency Modulation
FMO	Frequency Modulation Oscillator
FSK	Frequency Shift Keying
GHz	Gigahertz
HF	High Frequency
HPF	High Pass Filter
IC	Integrated Circuit
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
IMD	Intermodulation Distortion
I/O	Input/Output
IPA	Intermediate Power Amplifier
kHz	Kilohertz
LED	Light-Emitting Diode
LF	Low Frequency

LO	Local Oscillator
LPF	Low Pass Filter
MHz	Megahertz
MAI	Moseley Associates, Inc.
Mono	Monaural
ms	Millisecond
mW	Milliwatt

1 System Characteristics

1.1 Introduction

The PCL6000 Studio-to-Transmitter Link (STL) is designed to convey FM program material from a studio site to a transmitter site. The PCL6000 also simultaneously conveys control and secondary programming subcarriers. This equipment may also be used to provide high-quality program transmission in intercity relay service.

The PCL6000 series is a family of equipment that can operate in several bands from 150 MHz through 1.7 GHz. This operating manual covers the 220 MHz, 330 MHz, 450 MHz, 950 MHz, and 1.7 GHz bands of operation and the various configurations in those bands.

1.2 System Features

In addition to establishing a new industry standard for performance, the PCL6000 incorporates many new and innovative features to aid in the installation, operation, and maintenance of a system. Some of the features are:

- Very low distortion ceramic IF filters offering unprecedented selectivity.
- Peak reading meter for all major functions.
- Two-decade logarithmic true signal strength meter.
- Important status functions implemented with bi-color LED indicators.
- Designed to have a minimum of adjustments for trouble-free operation.
- Modular construction that provides excellent shielding and at the same time allows easy access to components.
- Multichannel Option: Up to sixteen pre-programmed channels available with remote operation capabilities.

NOTE: Please study the manual at least through Section 5 before attempting to install the system.

1.3 System Specifications

1.3.1 PCL6020, PCL6030, PCL6060 Composite System

Frequency Range:		148–174 MHz 215–240 MHz 300–330 MHz 440–470 MHz 890–960 MHz 1.5–1.7 GHz
Channel Spacing:		100–500 kHz (500 kHz standard)
Frequency Response:		± 0.2 dB or better, 30 Hz–53 kHz ± 0.3 dB or better, 30 kHz–75 kHz
Distortion (THD and IMD)		
	PCL6020:	0.2% or less, 30 Hz–7.5kHz (typically better than 0.15% at 1 kHz)
		Convolved stereo demodulation products greater than 50 dB below the 100% modulation reference level (400 Hz) from 7.5 kHz–15 kHz
	PCL6030/6060:	0.1% or less, 30 Hz–7.5 kHz (typically better than 0.1% at 1 kHz)
		Convolved stereo demodulation products greater than 50 dB below the 100% modulation reference level (400 Hz) from 7.5 kHz–15 kHz
Stereo Separation		
	PCL6020:	50 dB or better, 50 Hz–15 kHz (typically 55 dB or better)
	PCL6030/6060:	51 dB or better, 50 Hz–15 kHz (typically 55 dB or better)
Nonlinear Crosstalk		
	PCL6020:	50 dB or better (Sub to Main Channel)
	PCL6030/6060:	51 dB or better (Main to Sub Channel)
Signal-to-Noise Ratio		
	PCL6020:	72 dB or better (typically 75 dB) Demodulated,de-emphasized (left or right) Referenced to 100% modulation
	PCL6030/6060:	75 dB or better (typically 77 dB) Demodulated, de-emphasized (left or right) Referenced to 100% modulation
Emission:		500F9

1.3.2 PCL6020, PCL6030, PCL6060 Monaural System

Frequency Range:		148–174 MHz 215–240 MHz 300–330 MHz 440–470 MHz 890–960 MHz 1.5–1.7 GHz
Frequency Response:		± 0.3 dB or better, 30 Hz–15 kHz
Distortion (THD and IMD)		
	PCL6020:	0.2% or less, 30 Hz–15 kHz (typically better than 0.15% at 1 kHz)
	PCL6030/6060:	0.1% or less, 30 Hz–15 kHz (typically better than 0.10% at 1 kHz)
Signal-to-Noise Ratio		
	PCL6020:	72 dB or better (typically 75 dB) Referenced to 100% modulation
	PCL6030/6060:	75 dB or better (typically 77 dB) Referenced to 100% modulation
Operating Temperature:		-20°C to +70°C
Emission:		110F3 (no subcarrier) 110F9 (with 26 kHz control subcarrier) 230F9 (with 67 kHz program subcarrier)

1.3.3 PCL6010 Transmitter Specifications

Type:		Solid state Direct FM Frequency synthesized Crystal referenced
RF Power Output		
	800–960 MHz:	6 watts
	148–470 MHz:	8 watts
	1.5–1.7 GHz:	5 watts
RF Output Connector:		Type N Female, 50 ohm
Deviation (100% Modulation)		
	Composite:	± 50 kHz
	Monaural:	± 40 kHz
Frequency Stability:		Better than 0.00025% (2.5 ppm) from 0°C to 50°C
Spurious & Harmonic Emission:		More than 60 dB below carrier level
Modulation Capability:		One program and two subcarrier channels
Modulation Inputs		
	Composite:	3.5 V_{p-p} @ 6 Kilohms, unbalanced Frequency range: 30 Hz–80 kHz (1 BNC connector)

Monaural:	+10 dBm @ 600 ohms, balanced, floating Frequency range: 30 Hz–15 kHz (Barrier strip connector)
MUX 1:	1.5 V_{p-p} @ 4 Kilohms, unbalanced Frequency range: 85–200 kHz (1 BNC connector)
MUX 2:	1.5 V_{p-p} @ 4 Kilohms, unbalanced Frequency range: 85–200 kHz (1 BNC connector)
Power, AC:	100/120/220/240 VAC (±10%), 50/60 Hz, 70 watts
Dimensions:	3.5" (8.9 cm) high 19.0" (48.3 cm) wide 16.5" (41.9 cm) deep
Shipping Weight:	12.7 kg (28 lb) domestic

1.3.4 PCL6020, PCL6030, PCL6060 Receiver Specifications

RF Input Connector:	Type N female, 50 ohm
Sensitivity	
PCL6020 Composite:	120 mV or less required for 60 dB SNR; left or right channel de-emphasized, demodulated
PCL6020 Monaural:	20 mV or less required for 60 dB SNR
PCL6030/6060 Composite:	100 mV or less required for 60 dB SNR; left or right channel de-emphasized, demodulated
PCL6030/6060 Monaural:	20 mV or less required for 60 dB SNR
Selectivity	
Composite:	3 dB IF bandwidth: ± 125 kHz 80 dB IF bandwidth: ± 1.2 MHz
Monaural:	3 dB IF bandwidth: ± 90 kHz 80 dB IF bandwidth: ± 1.2 MHz
Spectral Efficient Composite:	3 dB IF bandwidth: ± 100 kHz 80 dB IF bandwidth: ± 1.0 MHz
Adjacent Channel Level (to degrade SNR by 3 dB)	
PCL6020:	+10 dBc
PCL6030/6060:	wide band: +20 dBc narrow band: +10 dBc
Modulation Outputs	
Composite:	3.5 V_{p-p} @ 200 ohm, unbalanced Frequency range: 30 Hz–80 kHz (2 BNC connectors, parallel connection)
Monaural:	+10 dBm @ 600 ohms, balanced Frequency range: 30 Hz–15 kHz (Barrier strip connector)
MUX:	1.5 V_{p-p} @ 100 ohm, unbalanced

		Frequency range: 85–200 kHz (2 BNC connectors, parallel connection)
Power, AC:		100/120/220/240 VAC (±10%), 50/60 Hz, 30 Watts
Power, DC Options		Isolated ground (factory standard) Chassis negative ground (user selectable)
	12 VDC: 24 VDC: 48 VDC:	10–20 VDC, 30 watts 18–36 VDC, 30 watts 36–72 VDC, 30 watts
Dimensions:		3.5" (8.9 cm) high 19.0" (48.3 cm) wide 16.5" (41.9 cm) deep
Shipping Weight:		12.7 kg (28 lb) domestic

1.4 System Description

1.4.1 PCL6010 Transmitter

The PCL6010 Transmitter is a high-fidelity broadband FM transmitter with a power output of 5–15 watts (depending on frequency and system configuration). It is capable of transmitting the program signal and two multiplex subcarriers with little degradation of signal quality over one link. The linearity and FM noise characteristics of the direct FM oscillator are exceptional. The transmitter is modular in construction and operation, and the system description given below follows the signal flow through the various modules.

Refer to Figures 1-1a and 1-1b, PCL6010 Transmitter Block and Level Diagram. Assembly drawings and schematics for the complete transmitter system and for its modules are located in Section 7.

Audio Processor

The Audio Processor is located in the TX Audio/Power Supply board. Three signal inputs are provided to the Audio Processor module—one audio (composite or monaural) signal and two multiplex signals. The composite input level is 3.5 $V_{p\text{-}p}$ (5.7 kohms), mono input level is +10 dBm (600 ohms, selectable), mux input level is 1.5 $V_{p\text{-}p}$. 75 μs pre-emphasis is selectable. The board is jumper-programmable for composite, mono, or digital input operation and level adjustments are provided for all functions. Summing amplifiers combine the inputs into a single baseband signal that is passed on to the FMO Synthesizer in the RF module.

FMO Synthesizer

The baseband signal from the Audio Processor modulates the frequency modulated oscillator (FMO) in the RF module. The FMO consists of a 60–80 MHz ultralinear, very low noise VCO which is phase locked to a crystal-controlled reference oscillator. The phase lock loop contains the frequency programming switches which allow the synthesizer to be changed in frequency steps of 25 kHz. The RF output of the FMO is filtered to attenuate any harmonics. With 100% modulation, the RF signal will deviate ±50 kHz (composite) or ±40 kHz (monaural) from the carrier. The output power of the FMO is approximately 1 mW.

1st Local Oscillator (950 MHz)

The 1st Local Oscillator (LO1) section of the RF module consists of an oven controlled crystal oscillator, a doubler, and a step recovery diode (SRD) multiplier. The oscillator operates at 102 MHz (nominal). The resultant multiplication factor of the LO is X10. The output (1020 MHz) is filtered and attenuated before being applied to the upconverter mixer. A level detector provides front panel metering information. The output power is approximately +10 dBm.

1st Local Oscillator (330/450 MHz)

The 1st Local Oscillator (LO1) section of the RF module consists of an oven controlled crystal oscillator, a doubler, and a step recovery diode (SRD) multiplier. The oscillator operates at 96.25 MHz (nominal). The resultant multiplication factor of the LO is X4. The output (385 MHz) is externally filtered and then attenuated before being applied to the upconverter mixer. A level detector provides front panel metering information. The output power is approximately +10 dBm.

1st Local Oscillator (220 MHz)

The 1st Local Oscillator (LO1) section of the RF module consists of an oven controlled crystal oscillator and a step recovery diode (SRD) multiplier. The oscillator operates at 97 MHz (nominal). The resultant multiplication factor of the LO is X3. The output (291 MHz) is externally filtered and then attenuated before being applied to the upconverter mixer. A level detector provides front panel metering information. The output power is approximately +10 dBm.

1st Local Oscillator (1.7 GHz)

The TX RF module output frequency (850 MHz, nominal) is multiplied (X2) in the Doubler Assembly to achieve the desired carrier frequency (1.7 GHz, nominal). Therefore, the operating frequency of the 1st LO is nearly identical to the 950 MHz band configuration. The 1st LO (LO1) section of the RF module consists of an oven controlled crystal oscillator, a doubler, and a step recovery diode (SRD) multiplier. The oscillator operates at 92 MHz (nominal). The resultant multiplication factor of the LO is X10. The output (920 MHz) is filtered and attenuated before being applied to the upconverter mixer. A level detector provides front panel metering information. The output power is approximately +10 dBm.

Up Converter

To preserve the low noise and low distortion characteristics of the FMO, the RF signal is up-converted to the required carrier frequency through the use of a double-balanced mixer and the 1st Local Oscillator (LO1). The appropriate mix product is selected with a bandpass filter. The Intermediate Power Amplifier (IPA) amplifies the signal to a level high enough to drive the RF power amplifier (RFA) or the Doubler Assembly in the 1.7 GHz system. The Upconverter/IPA is located in the RF module.

RF Amplifier (950 MHz)

The RF Amplifier module internally consists of a three-stage hybrid amplifier, which amplifies the input signal (40 mW, typical) to the nominal 6-watt transmitter output. The output is filtered to attenuate all higher order harmonics to a level of at least -60 dBc. The output is sampled via a dual directional coupler with detectors that provide an indication of the forward and reflected power of the RF amplifier. The final stage current is sampled and metered in this module.

RF Amplifier (450 MHz)

The RF Amplifier module internally consists of a three-stage hybrid amplifier, which amplifies the input signal (100 mW, typical) to the nominal 8-watt transmitter output. The output is filtered to attenuate all higher order harmonics to a level of at least -60 dBc. The output is sampled via a dual directional coupler with detectors that provide an indication of the forward and reflected power of the RF amplifier. The final stage current is sampled and metered in this module.

RF Amplifier (330 MHz)

The RF Amplifier module internally consists of a three-stage discrete design, which amplifies the input signal (100 mW, typical) to the nominal 8-watt transmitter output. The output is filtered to attenuate all higher order harmonics to a level of at least -60 dBc. The output is sampled via a dual directional coupler with detectors that provide an indication of the forward and reflected power of the RF amplifier. The final stage current is sampled and metered in this module.

RF Amplifier (220 MHz)

The RF Amplifier module internally consists of a two-stage discrete design, which amplifies the input signal (100 mW, typical) to the nominal 8-watt transmitter output. The output is filtered to attenuate all higher order harmonics to a level of at least -60 dBc. The output is sampled via a dual directional coupler with detectors that provide an indication of the forward and reflected power of the RF amplifier. The final stage current is sampled and metered in this module.

Doubler Assembly (1.7 GHz)

The output frequency of the TX RF module is one-half the desired carrier frequency (850 MHz, nominal). The output is applied to the Doubler Assembly which multiplies the signal (X2) and is filtered before being amplified by the RFA (1.7 GHz, nominal).

RF Amplifier (1.7 GHz)

The RF Amplifier module internally consists of a four-stage discrete design, which amplifies the input signal (1 mW, typical) to the nominal 5-watt transmitter output. The output is filtered to attenuate all higher order harmonics to a level of at least -60 dBc. The output is sampled via a dual directional coupler with detectors that provide an indication of the forward and reflected power of the RF amplifier. The final stage current is sampled and metered in this module.

Transmitter Control

The Transmitter Control section of the Audio/Power Supply board has several functions. One of these is to sense the AFC LOCK detect signal from the RF module. If this module goes out of lock, then the radiate control logic circuit provides a signal to the power supply to turn off the +12.5 VDC supply (+22 VDC for 1.7 GHz) to the IPA and RFA, causing the transmitter to stop radiating. Remote control functions are implemented in this circuitry.

Metering and Status

The Metering and Status circuitry on the Audio/Power Supply board conditions the various system parameter samples for accurate meter indications, and drives the status LEDs on the front panel. Remote status indications are also provided by this circuitry.

Power Supply (AC)

The Power Supply section of the Audio/Power Supply board converts any of four AC input voltages (100, 120, 220, 240 VAC) into the five regulated DC voltages required for the operation of the transmitter. The outputs are +15, -15, and +5 VDC for most of the system electronics. A high current +12.5 VDC (+22 VDC for 1.7 GHz) supplies the RFA. A regulated -12 VDC supply powers the crystal ovens in the 1st LO and the FMO/Synthesizer.

Power Supply (DC Option)

Transmitters configured for DC operation only (±12, ±24, and ±48 VDC) have internal switching power supplies to provide the system voltages. These supplies can be isolated from chassis ground to allow negative DC source operation. The RFA supply may be powered directly from the battery, depending on the primary DC source.

Multichannel Operation (Option)

The Channel Control board is pre-programmed to select the transmitter carrier frequency by controlling the FMO/synthesizer (in the RF module) and the modulation compensation circuitry (located on board). This board has facilities for over-ride of the pre-programmed channel frequencies (Channel 0 operation). Remote control of the channel selection is also provided on this board through access to the back panel. Channel selection and display is accessed by the user through the front panel. The Channel Control board connects to the RF module via a 25-pin D ribbon cable. The RF module must be compatible for multichannel operation. Please contact the factory for field retrofit of the system.

1.4.2 PCL6020, PCL6030, PCL6060 Receivers

The PCL6000 System has three receivers which are designed for different RF environments. The PCL6060 and PCL6030 are triple-conversion receivers which provide maximum out-of-band and adjacent channel protection. The PCL6060 exhibits superior front end performance in the presence of extremely strong RF fields, as it uses modules from the time-proven Moseley PCL606 STL. The PCL6020 is a dual-conversion receiver that provides maximum performance in all but the most demanding environments. Both systems are switchable to support mono or composite operation. The receivers are modular in construction and operation, and the system description given below follows the signal flow through the various modules.

Refer to Figures 1-2a/b, 1-3a/b, and 1-4a/b, Receiver Block and Level Diagrams. Assembly drawings and schematics for the complete receiver systems and for their modules are located in Section 7.

Preselector/Preamplifier (950 MHz, PCL6020/6030)

The Preselector/Preamplifier is located in the RF module. The antenna input signal is first passed through the preselector filter, which is a pcb-mounted helical bandpass filter with very low insertion loss. The output of the preselector filter is fed to the preamplifier providing low-noise gain. The postselector filter provides further filtering as well as image noise rejection.

Preselector Filter (950 MHz, PCL6060)

The antenna input signal is first passed through the Preselector Filter, which is a five-element, interdigital bandpass filter with a 20 MHz bandwidth and maximum insertion loss of 1.5 db. This filter has superior rejection due to its mechanical implementation.

Preamp/1st Mixer (950 MHz, PCL6060)

The output of the Preselector Filter is fed to the Preamp/1st Mixer module. This module incorporates an adjustable PIN diode attenuator for user-adjustable front end protection. The low-noise, high-intercept point preamplifier is followed by the image noise filter. The 1st Mixer down-converts the carrier to the first IF (70 MHz) by mixing with the 1st LO and is buffered for transmission to the Double Converter/LO3 module.

Preselector Filter (220–450 MHz)

The antenna input signal is first passed through the Preselector Filter, which is a three-element, helical bandpass filter with an 8 MHz bandwidth and maximum insertion loss of 1.5 db. This filter has superior rejection due to its mechanical implementation.

Preselector Filter (1.7 GHz)

The antenna input signal is first passed through the Preselector Filter, which is a five-element, interdigital bandpass filter with a 20 MHz bandwidth and maximum insertion loss of 1.5 db. This filter has superior rejection due to its mechanical implementation.

Mixer (PCL6020/6030)

The Mixer is located in the RF module when configured as a PCL6020 or PCL6030. The carrier frequency is mixed with the 1st Local Oscillator (LO1) signal to provide down conversion to the first intermediate frequency (IF) of 70 MHz (nominal). The IF signal is buffered to overcome mixer conversion loss.

1st Local Oscillator (950 MHz)

The receiver 1st LO is identical to the transmitter 1st LO referenced in section 1.4.1.

1st Local Oscillator (330/450 MHz)

The receiver 1st LO is identical to the transmitter 1st LO referenced in section 1.4.1.

1st Local Oscillator (220 MHz)

The receiver 1st LO is identical to the transmitter 1st LO referenced in section 1.4.1.

1st Local Oscillator (1.7 GHz)

The 1st Local Oscillator (LO1) section of the RF module consists of an oven controlled crystal oscillator, a doubler, and a step recovery diode (SRD) multiplier. The oscillator operates at 102 MHz (nominal). The resultant multiplication factor of the LO is X16. The output (1632 MHz) is externally filtered and then attenuated before being applied to the upconverter mixer. A level detector provides front panel metering information. The output power is approximately +10 dBm.

2nd Local Oscillator

The 2nd Local Oscillator (LO2) is located in the RF module and is identical to the transmitter FMO except for operating frequency and modulation capability. LO2 consists of a 70–90 MHz ultralinear, very low noise VCO which is phase locked to a crystal-controlled reference oscillator. The phase lock loop contains the frequency programming switches which allow the synthesizer to be changed in frequency steps of 25 kHz. The RF output of LO2 is filtered to attenuate any harmonics. The output level is approximately +7 dBm.

Double Converter/LO3 (PCL6030/6060)

The Double Converter/LO3 module provides the second and third down-conversions of the IF signal and establishes the selectivity characteristics of the receiver. The second IF is at 10.7 MHz and two phase-linear ceramic filters are used to provide system selectivity (composite or monaural). The second of these two filters is switch-selectable to allow the user to minimize distortion in those situations where the added selectivity is not necessary.

The 3rd Local Oscillator (LO3) is located in the Double Converter/LO3 module and is used for the third down-conversion to 3 MHz. LO3 is a crystal oscillator operating at 13.7 MHz. The output level is +7 dBm.

FM Demod (PCL6030/6060)

The FM Demod module has three major functions. One is to extract the baseband information from the FM carrier. The second function is to generate the RF signal strength voltage that is applied to the meter in the RF LEVEL position, and the third is to establish the mute or squelch threshold of the receiver. The signal is first passed through a 3 MHz IF amplifier and a phase-linear 3 MHz bandpass filter. At this point, the signal is split and sent to both the FM demodulator and the log IF amplifier.

For FM demodulation, the signal runs through a four-stage limiting IF amplifier, the output of which passes on to the ultra-linear pulse-counting FM demodulator. This demodulator is extremely wideband and adjustment free. The output of the FM demodulator is low-pass filtered

and sent to a low noise baseband amplifier, which raises the signal level to a useful system level. The output is then sent to the Audio/Power Supply board.

IF Demod (PCL6020)

The IF Demod module provides down conversion to the second IF (10.7 MHz), sets system selectivity in the second IF, extracts the baseband information from the carrier, provides the logarithmic RF signal strength voltage for metering, and establishes the mute threshold point of the receiver.

Baseband Processor

The main functions of the Baseband Processor circuitry on the Audio/Power Supply board are to split the baseband signal into two frequency bands: 30 Hz to 80 kHz for composite, and 85 kHz to 200 kHz for MUX. In the extended baseband version of the PCL6000, the composite band spans 30 Hz to 110 kHz, and the MUX passband extends from 120 kHz to 200 kHz. For mono, the split is 30 Hz to 15 kHz for audio and 28–85 kHz for MUX. This module also contains the FET mute switch, which is controlled by the mute comparator output of the Mute and Transfer circuitry. The signal is then passed through a high-frequency amplitude corrector, which compensates for the baseband high-frequency roll-off caused by the 10.7 MHz IF bandpass filters, to restore proper amplitude response to the baseband signal.

The signal is then fed to an audio amplifier and an 80 kHz (composite) or 15 kHz (mono) low-pass filter. The output of this filter passes through an active group delay equalizer, which compensates for the group delay variations of the low-pass filter. This signal is then buffered by an output amplifier that provides 3.5 V_{p-p} output for 100% modulation. The output of the high-frequency amplitude corrector is also passed to a MUX high-pass filter (80 kHz composite, 22 kHz mono) and then goes to the MUX amplifier. The output of this amplifier drives a MUX low-pass filter (200 kHz composite, 85 kHz mono) which is then buffered to yield the MUX nominal output of 1.5 V_{p-p}.

Mute and Transfer

The Mute and Transfer circuitry located in the Audio/Power Supply board mutes the audio signal during periods of insufficient RF signal strength or for transferring operation to another receiver.

Metering and Status

The Metering and Status circuitry, located in the Audio/Power Supply board, conditions the metering samples and drives the status LED on the front panel and the front-panel meter. Remote status functions are also provided.

Power Supply (AC)

The Power Supply section of the Audio/Power Supply board converts any of four AC input voltages (100, 120, 220, 240 VAC) into the four regulated DC voltages required for the operation of the receiver. The outputs are +15, -15, and +5 VDC for the most of the system electronics. A regulated -12 VDC supply powers the crystal ovens in the 1st and 2nd LO.

Power Supply (DC Option)

Receivers configured for DC operation only (±12, ±24, and ±48 VDC), have internal switching power supplies to provide the system voltages. These supplies can be isolated from chassis ground to allow negative DC source operation.

Multichannel Operation (Option)

The Multichannel Control board is pre-programmed to select the receiver frequency selection by controlling the LO2/synthesizer (in the RF module). This Control board has facilities for over-ride

of the pre-programmed channel frequencies (Channel 0 operation). Remote control of the channel selection is also provided on this board through access to the back panel.

Channel selection and display is accessed by the user through the front panel. The Channel Control board connects to the RF module via a 25-pin D ribbon cable. The RF module must be compatible for multichannel operation. Please contact the factory for field retrofit of the system.

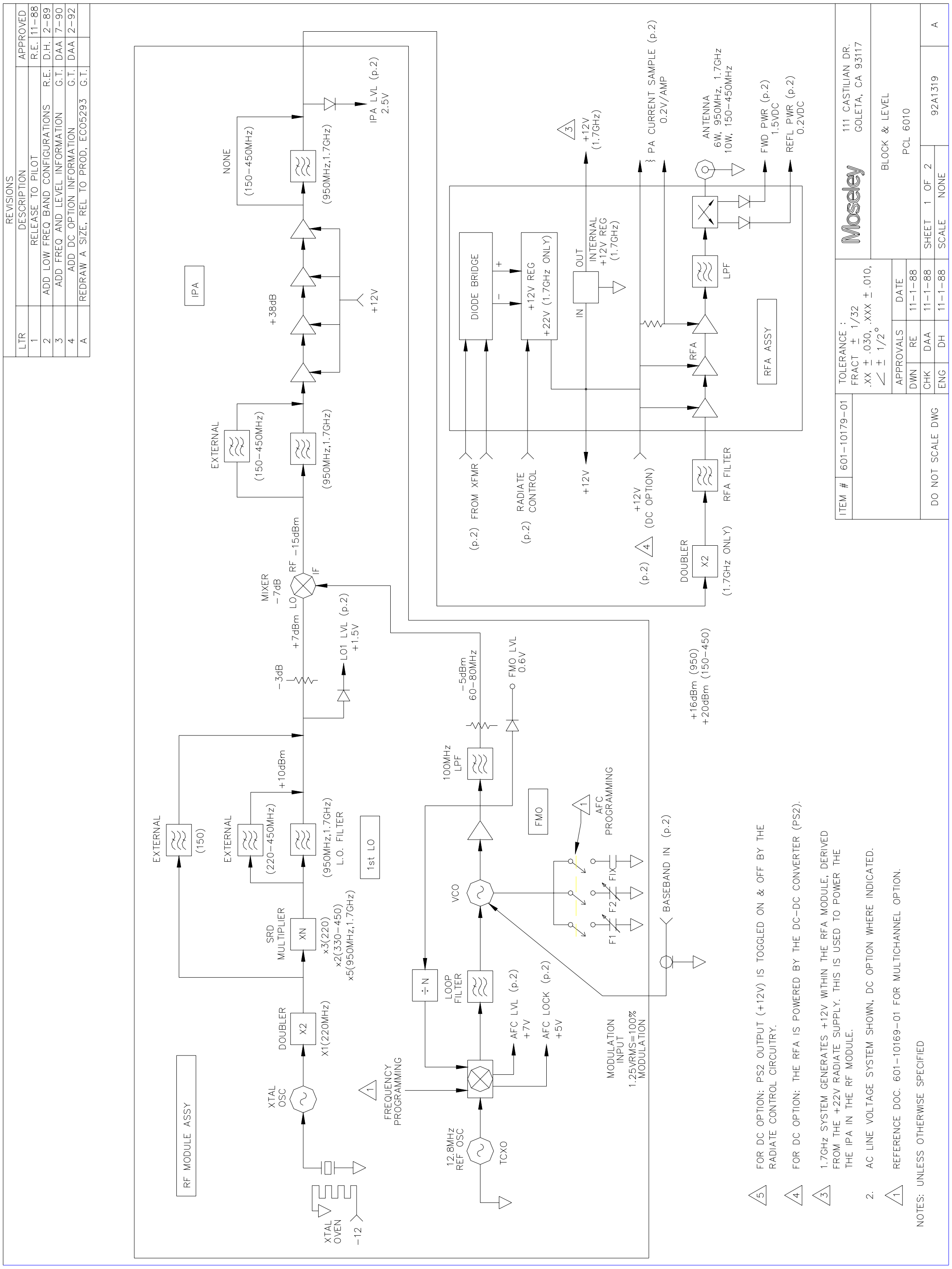


Figure 1-1a PCL6010 Transmitter Block and Level (92A1319 R: A Sheet 1 of 2)

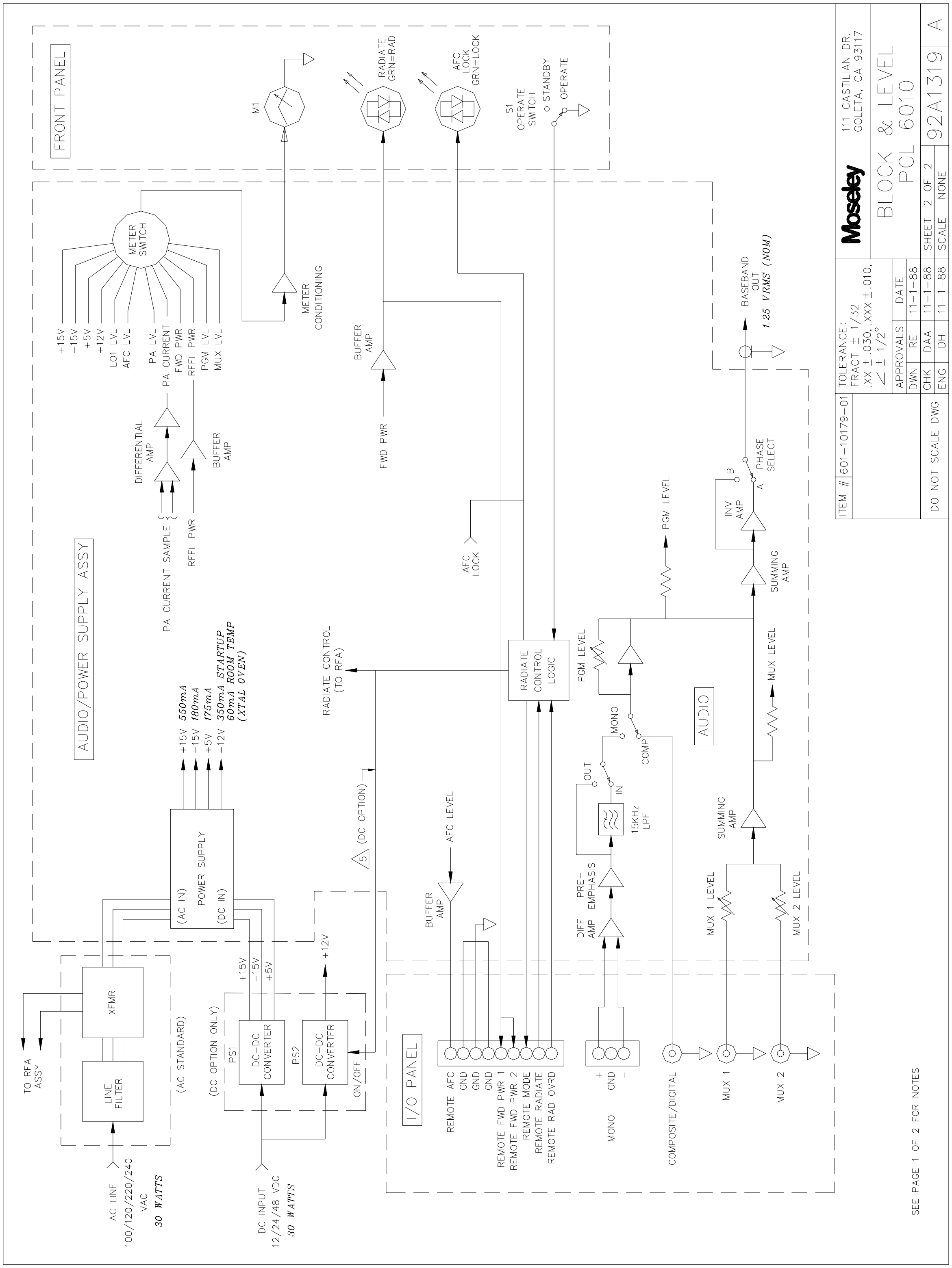


Figure 1-1b PCL6010 Transmitter Block and Level (92A1319 R: A Sheet 2 of 2)

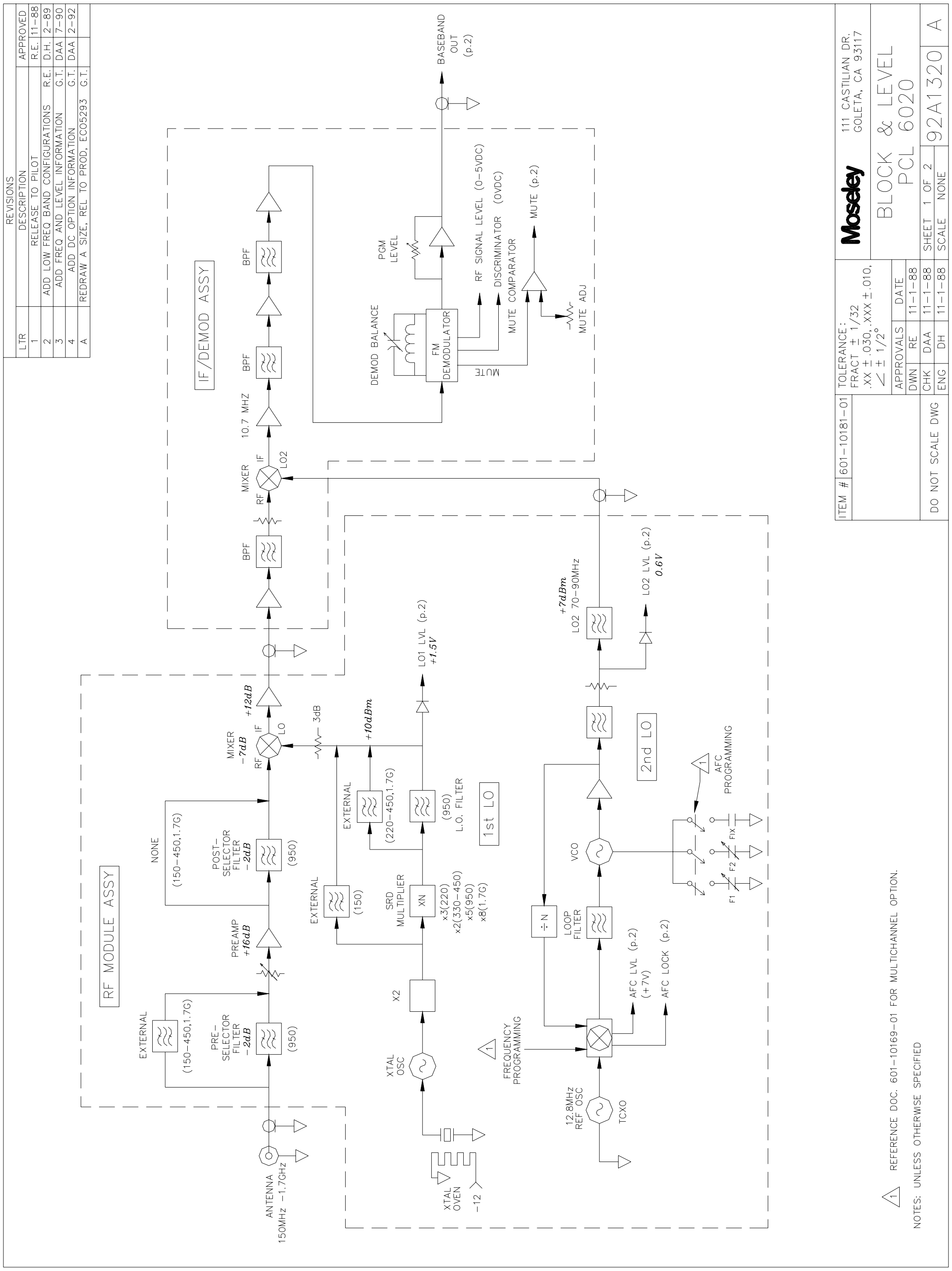


Figure 1-2a PCL6020 Receiver Block and Level (92A1320 R: A Sheet 1 of 2)

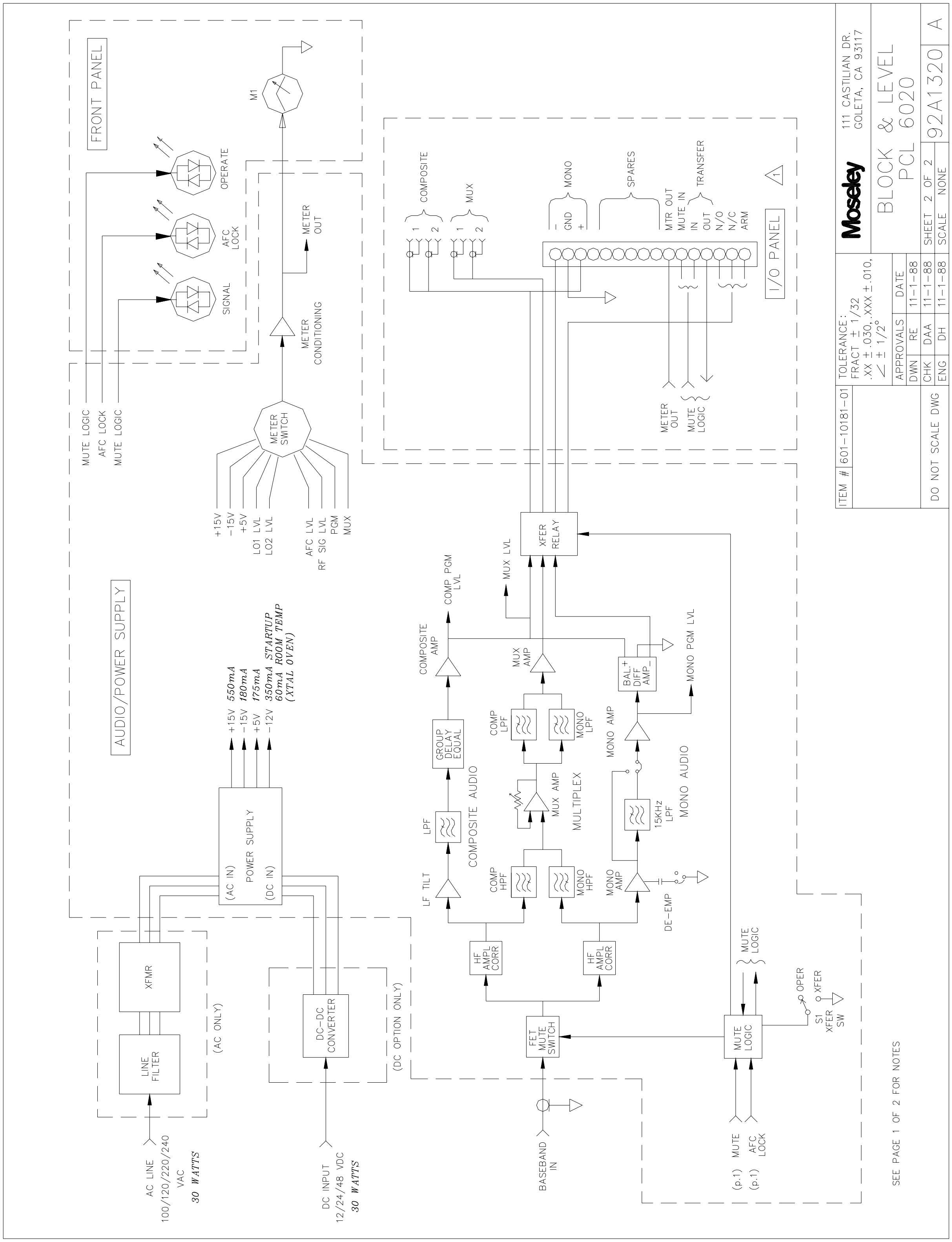


Figure 1-2b PCL6020 Receiver Block and Level (92A1320 R: A Sheet 2 of 2)

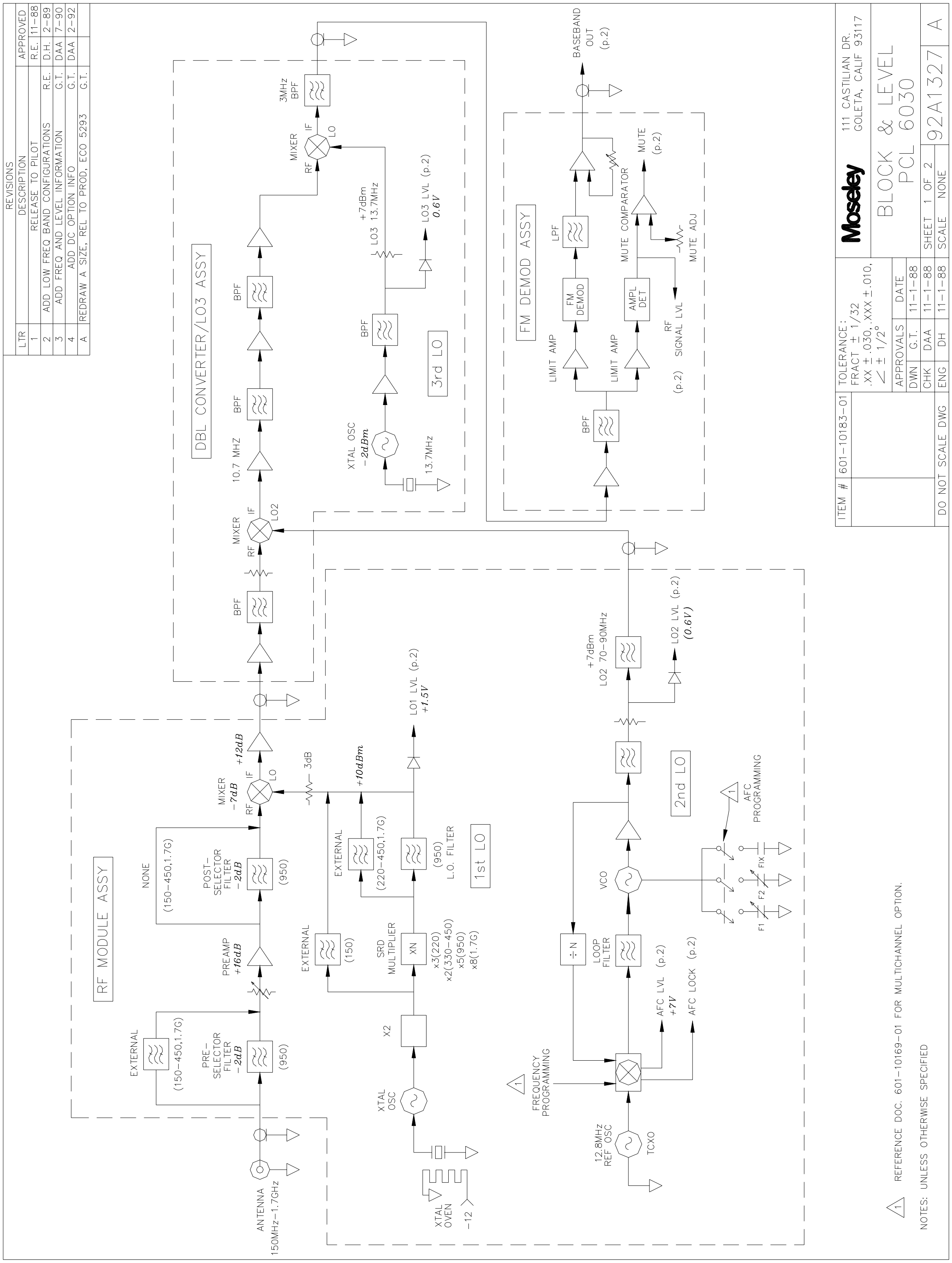


Figure 1-3a PCL6030 Receiver Block and Level (92A1327 R: A Sheet 1 of 2)

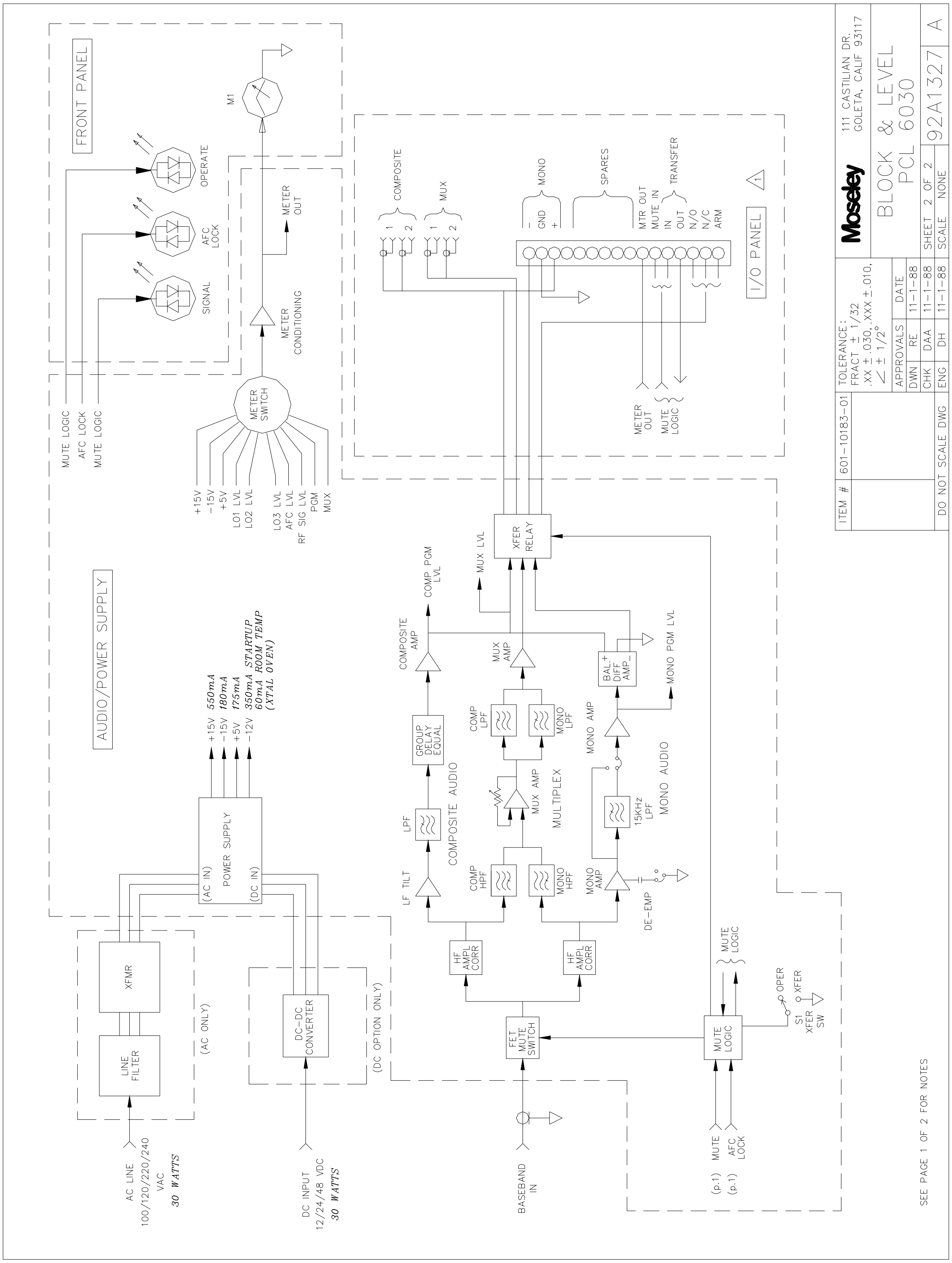
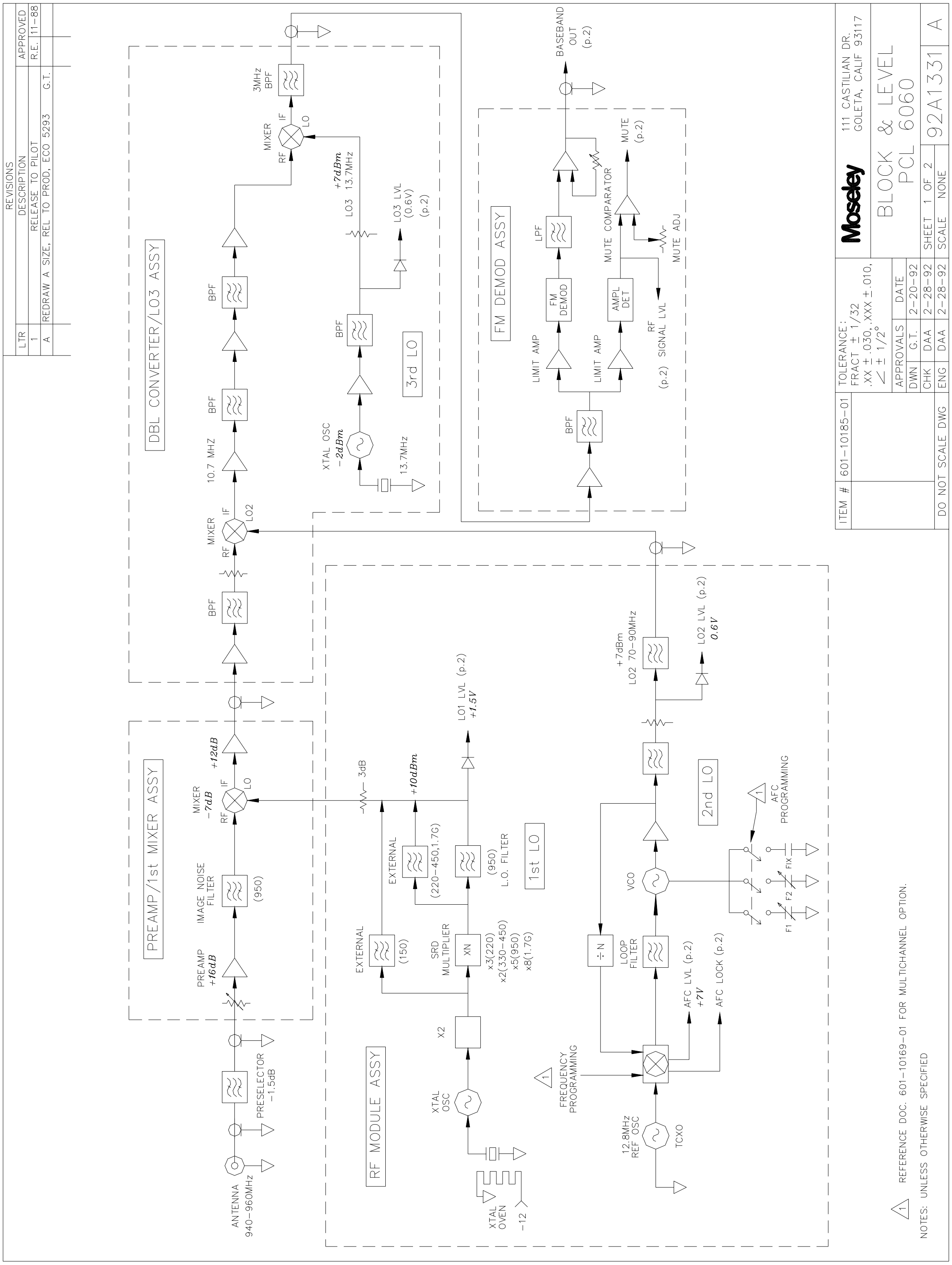


Figure 1-3b PCL6030 Receiver Block and Level (92A1327 R: A Sheet 2 of 2)



REVISIONS
LTR
DESCRIPTION
APPROVED
1
RELEASE TO PILOT
R.E. 11-88
A
REDRAW A SIZE, REL TO PROD, ECO 5293
G.T.
ANTENNA
940-960MHz
PRESELECTOR
-1.5dB
PREAMP
+16dB
IMAGE NOISE
FILTER
(950)
MIXER
-7dB
RF
IF
LO
+12dB
PREAMP/1st MIXER ASSY
DBL CONVERTER/LO3 ASSY
BPF
10.7 MHZ
MIXER
LO2
3MHz
BPF
XTAL OSC
-2dBm
13.7MHz
LO3
+7dBm
13.7MHz
LO3 LVL
(0.6V)
(p.2)
3rd LO
FM DEMOD ASSY
LIMIT AMP
FM
DEMOD
AMPL
DET
LPF
MUTE COMPARATOR
MUTE ADJ
MUTE
(p.2)
RF
SIGNAL LVL
(p.2)
BASEBAND
OUT
(p.2)
RF MODULE ASSY
XTAL
OSC
XTAL
OVEN
-12
X2
SRD
MULTIPLIER
XN
x3(220)
x2(330-450)
x5(950)
x8(1.7G)
EXTERNAL
(150)
(220-450,1.7G)
(950)
L.O. FILTER
1st LO
3dB
+10dBm
LO1 LVL (p.2)
+1.5V
2nd LO
12.8MHz
REF OSC
TCXO
FREQUENCY
PROGRAMMING
LOOP
FILTER
÷ N
VCO
AFC LVL (p.2)
+7V
AFC LOCK (p.2)
AFC
PROGRAMMING
F1
F2
FIX
+7dBm
LO2 70-90MHz
LO2 LVL (p.2)
0.6V
NOTES: UNLESS OTHERWISE SPECIFIED
1. REFERENCE DOC. 601-10169-01 FOR MULTICHANNEL OPTION.
ITEM # 601-10185-01
TOLERANCE:
FRACT ± 1/32
.XX ± .030, .XXX ± .010,
∠ ± 1/2°
APPROVALS
DATE
DWN
G.T.
2-20-92
CHK
DAA
2-28-92
ENG
DAA
2-28-92
DO NOT SCALE DWG
Moseley
111 CASTILIAN DR.
GOLETA, CALIF 93117
BLOCK & LEVEL
PCL 6060
SHEET 1 OF 2
SCALE NONE
92A1331
A

Figure 1-4a PCL6060 Receiver Block and Level (92A1331 R: A Sheet 1 of 2)

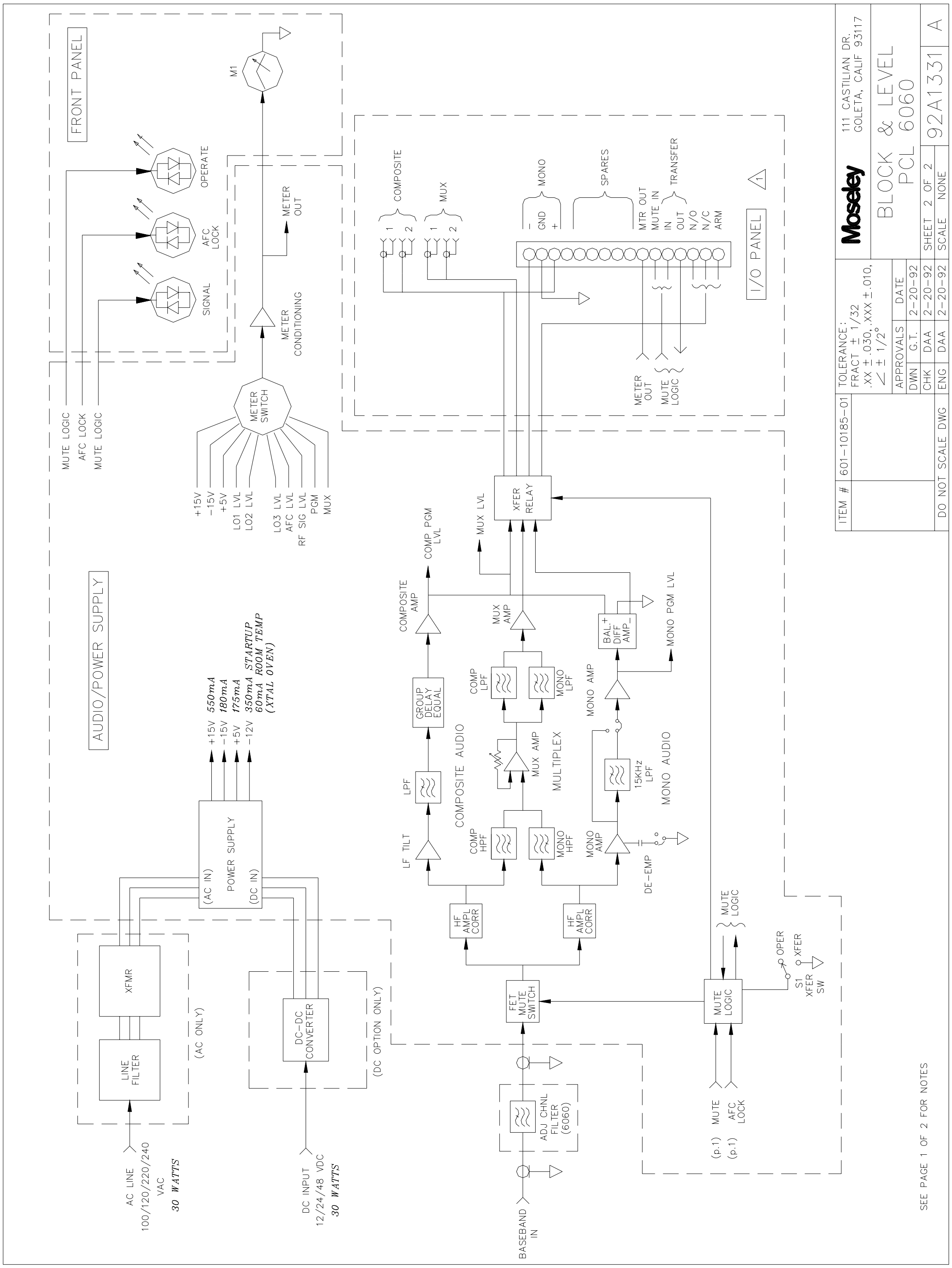


Figure 1-4b PCL6060 Receiver Block and Level (92A1331 R: A Sheet 2 of 2)

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Moseley

2 Installation

2.1 Unpacking

The PCL6000 transmitter and receiver should be carefully unpacked and inspected for shipping damage. Should inspection reveal any shipping damage, visible or hidden, immediately file a claim with the carrier. Keep all packing materials at least until the performance of the system is confirmed. If possible, save all packing materials in case the unit must be shipped in the future.

We recommend removal of the top covers of both the transmitter and receiver for a brief inspection of the internal components. Verify that assemblies and cables are mechanically secure. Check also for socketed components that may have been jarred loose or partially dismounted. This is a good time to familiarize yourself with the various assemblies and modules, using the Block and Level diagrams (Figures 1-2 through 1-4) and the drawings of Section 7. After the internal inspection, replace the top covers.

CAUTION:

Do not attempt any adjustments of any kind until the nature of each adjustment is understood.

Do not apply power to the receiver until the procedure in Section 2.2.1 is completed.

Do not apply power to the transmitter until the procedure in Section 2.2.1 is completed and a proper load is connected to the RF output.

Do not remove the covers on the transmitter RF Amplifier module.

2.2 Power

2.2.1 AC Line Voltage Selection

WARNING Failure to ground the third lead of the input power cord may result in hazardous shocks to personnel.

The transmitter and receiver each have the capability of operating at one of four nominal AC power source voltages: 100, 120, 220, or 240 VAC, 50–60 Hz. The units are shipped for 120 VAC operation, unless otherwise specified.

Select the operating voltage by programming the line filter/fuse holder on the back panel as shown in Figure 2-1. The desired voltage should be visible when the voltage selection card is inserted. If operating voltage is changed, change the fuse in accordance with Table 2-1.

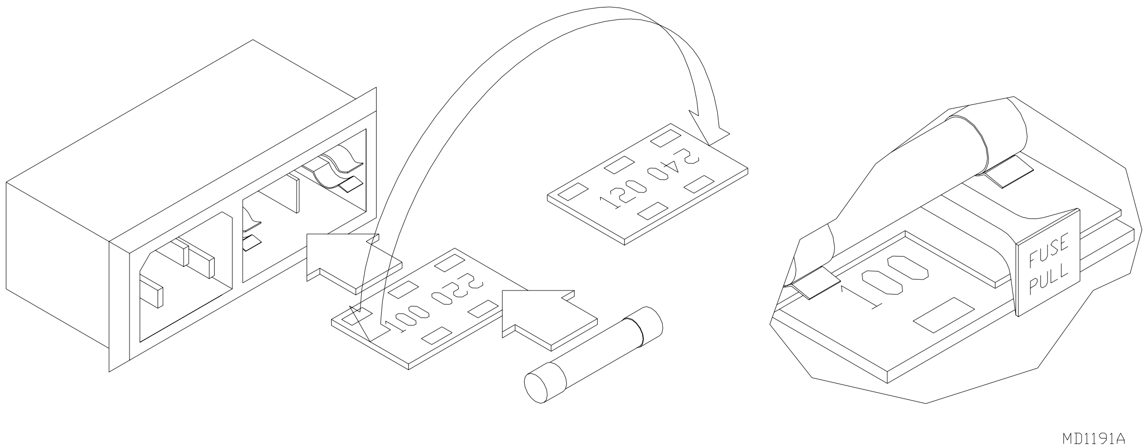


Figure 2-1
Line Filter/Fuse Holder Programming
(Detail shows 100 VAC operation selected)

Table 2-1
Transmitter and Receiver Fuse Settings

Line Voltage	**Transmitter Fuse** (Slow Blow)	**Receiver Fuse** (Slow Blow)
100 VAC	2 A	1 A
120 VAC	2 A	1 A
220 VAC	1 A	0.5 A
240 VAC	1 A	0.5 A

2.2.2 DC Option

For DC operation, verify the correct fuse is installed. Table 2-2 applies to most DC units. Due to possible technical issues at the factory, ALWAYS replace the fuse with the same type and rating of fuse installed by the factory.

Table 2-2
Transmitter and Receiver Standard DC Fuse Values

Input Voltage	Transmitter Fuse (Slow Blow)	Receiver Fuse (Slow Blow)
±12 VDC	5 A	3 A
±24 VDC	2 A	2 A
±48 VDC	1 A	1 A

2.3 Pre-installation Checkout

While the user has both the transmitter and receiver at the same location, we suggest that a pre-installation checkout of the system be performed before mounting the equipment in racks separated by many miles. Figure 2-2 shows one of the several possible bench test setups.

Minimum Equipment to Perform Bench Test

Instrument Type	Suggested Model	Critical Specifications
RF Wattmeter	Bird 43 or equivalent	measurement range 5–15 watts
Fixed Attenuator	Philco 662A-30 or Sierra 661A-30	30 dB, 1 GHz 50 Ohms, 20 Watts
Adjustable Attenuator	Kay Elemetrics Model 432D	0–100 dB
Audio Signal Generator	Tektronix SG505 or equivalent	low-distortion
Audio Distortion Analyzer	Tektronix AA501 or equivalent	

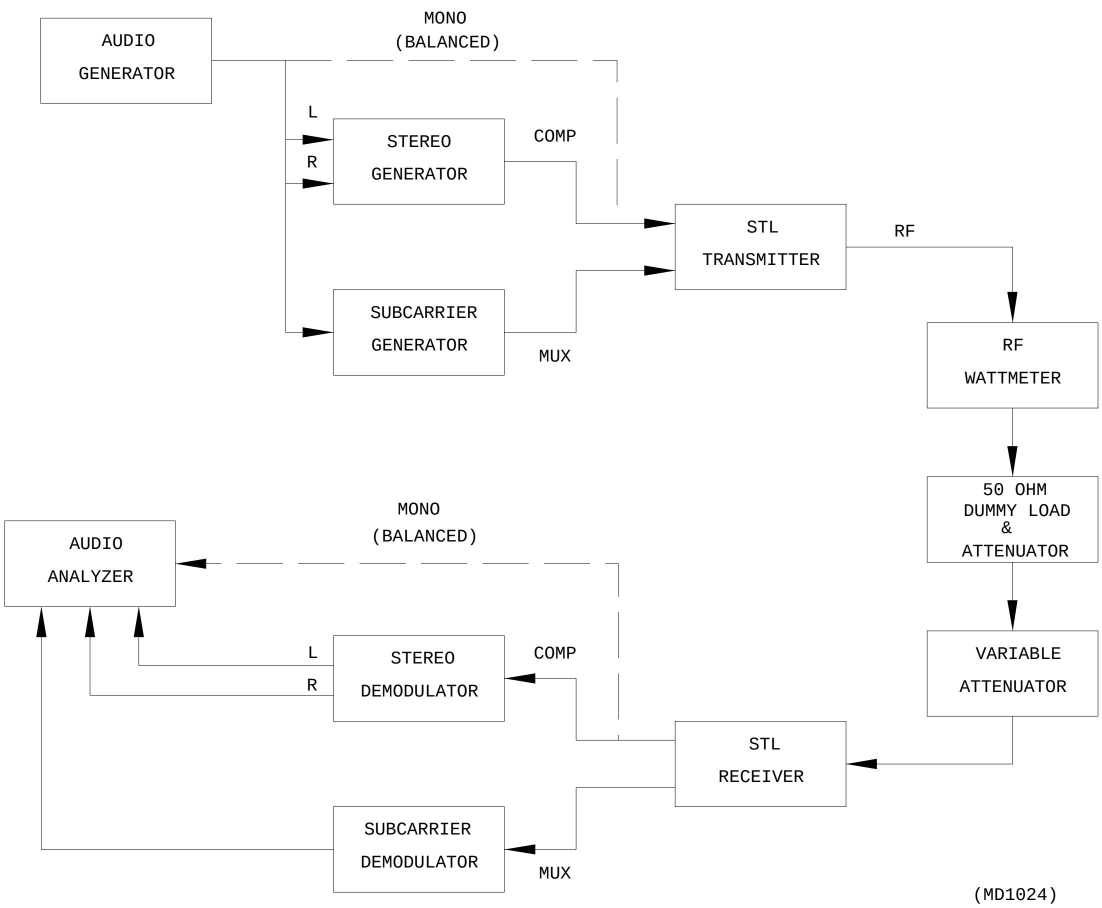


Figure 2-2
Typical Bench Test Setup

More extensive testing can be accomplished using a stereo generator and demodulator combination and/or a sub-carrier generator and demodulator combination.

CAUTION

Always operate the transmitter terminated into a proper 50-ohm load.

Always attenuate the signal into the receiver to less than 3000 μV (Approximately 75 dB attenuation between the transmitter and receiver).

Observe these precautions when performing any bench test. Otherwise the transmitter final transistor may be destroyed or the receiver preamplifier transistors may be damaged.

Bench Test Procedure

With the wattmeter and dummy load connected to the transmitter, apply AC power to the receiver. The OPERATE LED will be red, indicating that there is no RF.

Apply AC power to the transmitter and place the OPERATE/STANDBY switch in the OPERATE position. “AFC LOCK” and “RADIATE” will be red for several seconds and then turn green. Observe that the wattmeter will indicate between 5 to 15 watts (depending on the frequency band of operation) and that the transmitter meter will provide readings of FWD PWR. A brief period after “RADIATE” becomes green, “OPERATE” on the receiver will change from red to green. The RF LEVEL meter position on the receiver may be selected to determine the strength of the RF signal applied to the receiver. Adjust the variable attenuator until an input signal strength of approximately 1000 μV is indicated. It should be mentioned that in any bench testing where the transmitter and receiver are in close proximity, there can be sufficient RF leakage from the cables to render computations of applied signal strength impractical based upon power and attenuation data.

Apply a 3.5 Vp-p signal (1.237 VRMS) from the audio signal generator at 400 Hz to the composite input of the transmitter. “PGM LEVEL” at the transmitter and receiver meters may be selected and should indicate 0 on the dB scale. The output voltage from a composite output of the receiver can be fed to an audio analyzer. The output voltage should be approximately 3.5 Vp-p (1.237 VRMS). The audio input signal may be removed and the broadband signal-to-noise ratio (SNR) determined:

$$\mathrm{SNR} = 20\log\frac{(\text{RMS voltage with modulation})}{(\text{RMS voltage without modulation})}$$

(Note: Demodulated stereo SNR will be approximately 12 dB greater than broadband SNR.)

While this concludes the basic bench test of the units, the user may want to run further experiments to become familiar with the system. Sections 3, 4, and 5 should be consulted for a thorough understanding of the STL system before proceeding with any higher level testing. It must be noted that any testing for stereo performance must be accomplished with a very high quality stereo generator and stereo demodulator combination. The stereo generator and demodulator combination should be tested back-to-back to determine their performance independently of the STL link.

2.4 Rack Installation

The PCL6000 units are designed for mounting in standard rack cabinets, preferably between waist and shoulder height. The transmitter and receiver have mounting holes for Chassis Trak C-300-5-1-14 chassis rack slides. If the rack will accept chassis rack slides, their use is recommended. If chassis rack slides are used, be sure to leave at least a 15-inch service loop in all cables to the equipment.

When mounting the transmitter or receiver in a rack, the unit must have an unobstructed free flow of cooling air across the rear panel. Continued operation in a confined environment can cause the ambient temperature to exceed specification, resulting in reduced life or catastrophic failure.

When a PCL6000 Receiver is used with a PCL606, PCL600, PCL505 or PCL303 receiver, a transfer panel (such as a TPR-2) must be used to accomplish automatic switchover, and should be mounted between the two receivers. Receiver automatic switchover interconnections are detailed in Section 2.9 (Main/Standby Interconnect).

When two transmitters are in a system at a site, an automatic transfer panel such as the TPT-2 should be mounted between them. The TPT-2 will allow interconnection of a PCL6000 with another PCL6000, PCL600, PCL606, PCL505, or PCL303 transmitter and can provide automatic switchover in the event of a detectable failure in the transmitter as shown in Section 2.9.1 (Transmitter Interconnect).

2.5 Antenna Installation

The installation of the antennas and associated feed lines determines to a large extent the long-term reliable operation of the STL. Experience has indicated that a reasonably clear path having a 0.6 Fresnel zone clearance along with good feed-line installation results in a highly predictable signal level at the receiver. The appendix contains a series of instructions, calculation sheets, typical gain and loss characteristics, and nomographs to enable the received signal level to be predicted. Since the PCL6000 has a signal strength meter, it is possible to determine the quality of the antenna installation and path compared to the calculations.

Experience at 960 MHz has indicated that for reliable year-round operation with a predominantly overland path and 0.6 Fresnel zone clearance, a 20 dB fade margin should be used. At least a 25 dB fade margin should be allowed if the path is over water or flat terrain with little vegetation.

2.6 Transmission Cables

The transmission cable between antenna and transmitter or receiver should be coaxial cable whose loss characteristics are known. Typical quality low-loss foam dielectric lines such as Andrew LDF4-50, a 0.5 inch diameter cable, has a 2.4 dB loss per 100 feet at 950 MHz. This cable will generally be adequate where the total cable run (at both transmitter and receiver) is less than 300 feet and there is a good transmission path of less than 10 miles.

When the total transmission cable length exceeds 300 feet, an obstructed or grazing path occurs, or the path length exceeds 10 miles, a lower loss cable such as Andrew LDF5-50, a 7/8 inch diameter cable with a loss of 1.4 dB per 100 feet, is recommended.

To reduce system losses, it is important to select type N connectors that are designed for the type of transmission cable used in the system. The connectors must be installed in accordance with the manufacturer's recommendations. It may take only one improperly installed connector to reduce the received signal strength sufficiently to provide only marginal system performance.

Reasonable care should be exercised during the installation of the transmission cable. Never put a sharper bend radius in the cable than recommended by the manufacturer. Too sharp a bend can cause internal cable damage that is not observable on the outside of the cable. This damage can result in excessive loss in the cable. Since the higher quality transmission cables are relatively inflexible, Moseley Associates has several short “pigtail” assemblies available. These pigtails are designed to attach to the ends of the transmission cable and allow movement of the equipment or antenna with less chance of damaging the transmission cable or the connectors on the equipment. These pigtails and appropriate connectors are available in installation kits for the more popular types of transmission cable.

Should it be desired to mount the antenna on a series-fed standard broadcast tower, the required isolation can be obtained with the installation of a Moseley Associates Isocoupler at the base of the series-fed antenna. Isolation at standard broadcast frequencies is high, and the isocoupler introduces only approximately 1.5 dB loss at the STL frequency.

Figure 2-3 shows details of a typical PCL6000 site installation.

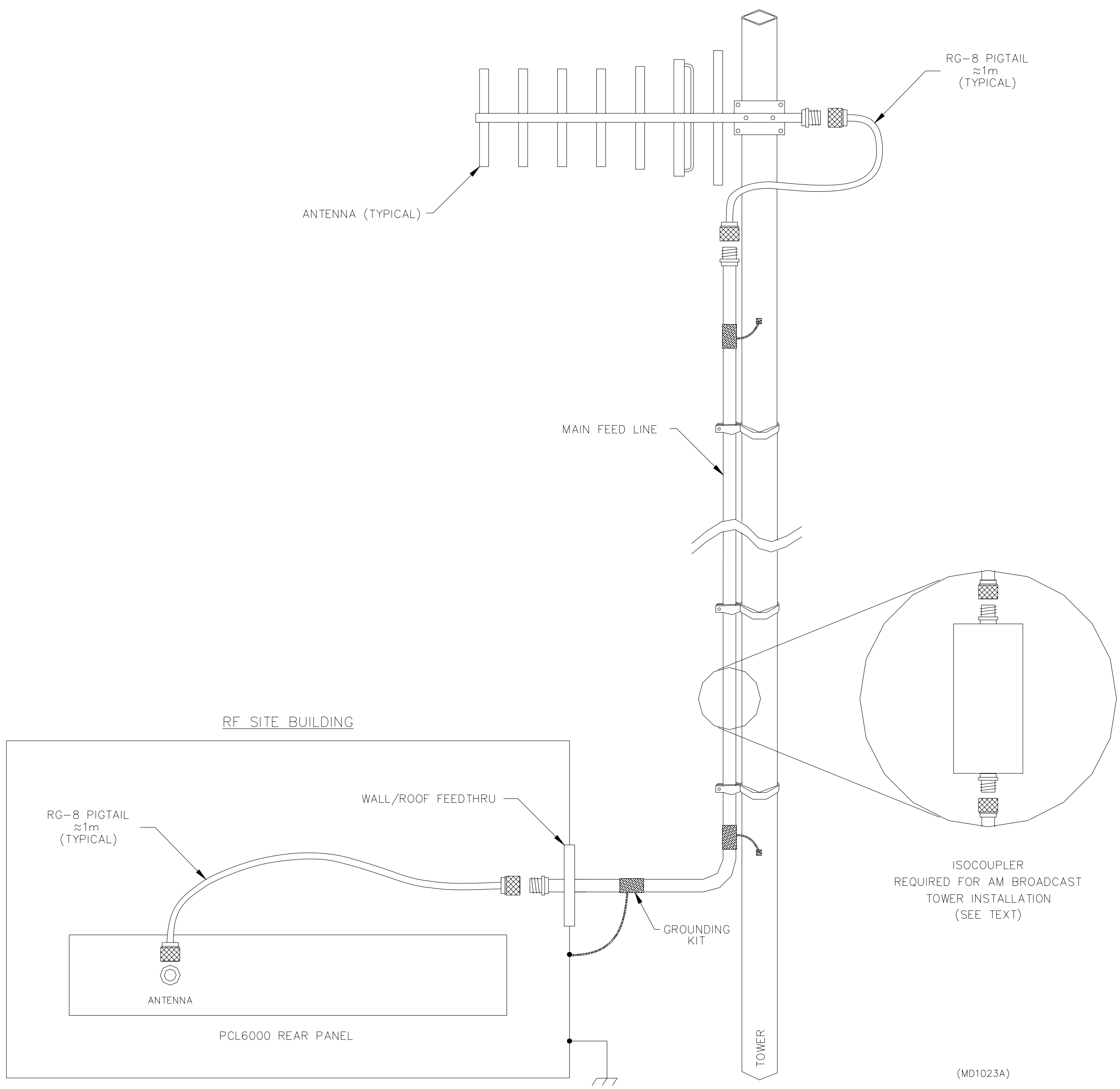


Figure 2-3
Typical PCL6000 Site Installation

2.7 Program and Multiplex Installation — Transmitter

Figure 2-4 depicts the typical interconnection of a PCL6000 as would normally be found at the studio. The left and right program material is first passed through an automatic gain control (AGC) unit to establish the nominal system levels. This is followed by a frequency-conscious audio limiter to prevent over-modulation of the system as the result of the normal pre-emphasis curve used in FM broadcasts.

It is highly desirable that the gain control or limiting units for each channel be interconnected so that any processing that occurs on one channel is performed in the same manner on the other channel.

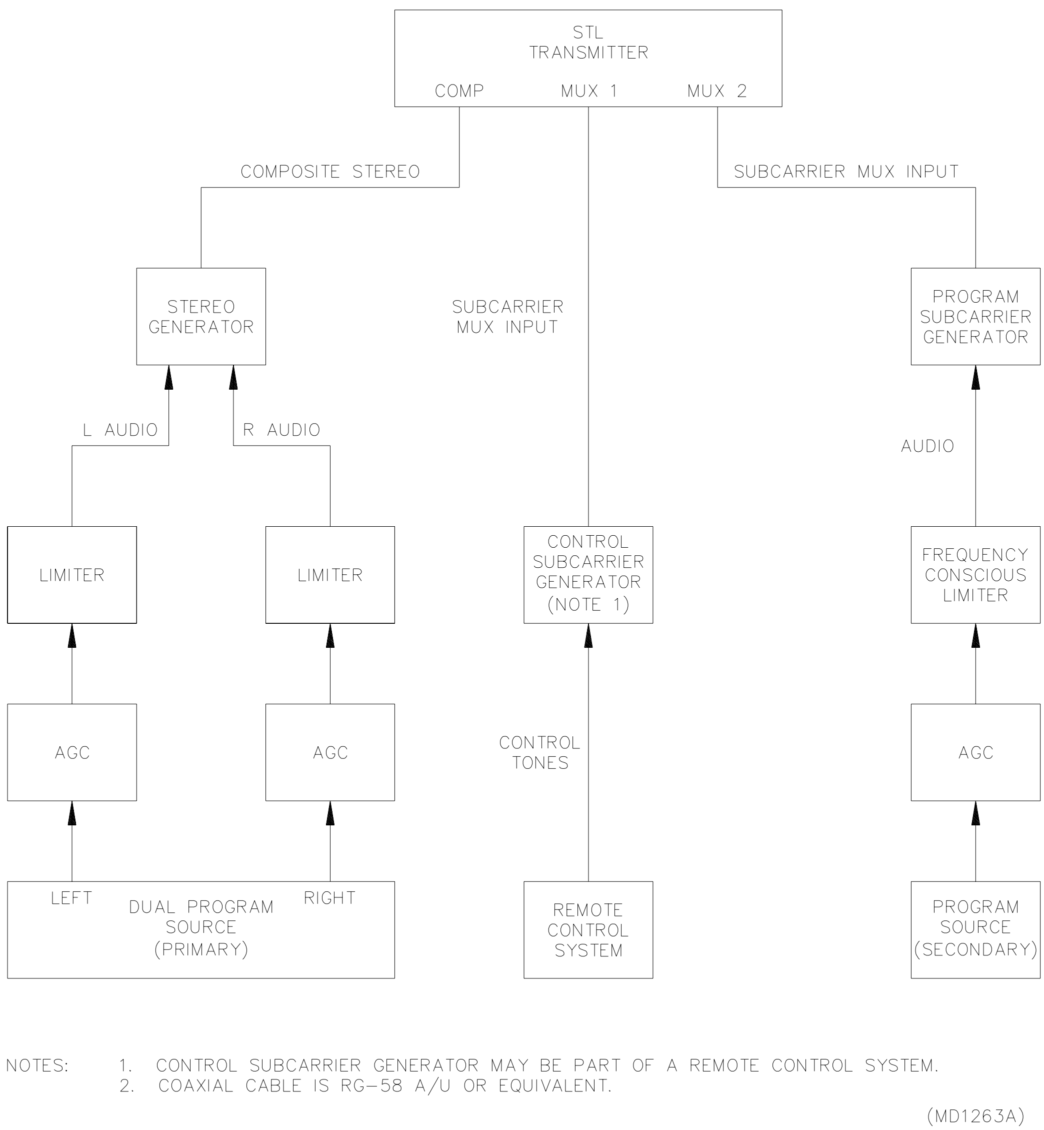


Figure 2-4
Transmitter PGM and MUX Interconnect — Composite

The limiter outputs are then fed to a stereo generator for conversion of the left and right channels into the standard FM composite baseband signal. The composite signal is then fed into the composite input of the PCL6000. The standard composite signal is unbalanced, 3.5 Vp-p for 100 percent modulation. BNC connectors with type RG-58 A/U coaxial cable are generally used for the interconnection.

CAUTION Never over-modulate the STL transmitter, as this will cause increased distortion in the received signal and, possibly, interference to other users in the STL band.

The secondary program audio is generally passed through an AGC stage and/or a frequency conscious limiter into a subcarrier generator with a center frequency of 185 kHz (67 kHz for mono). The subcarrier for the secondary program audio is fed to the PCL6000 MUX 2 subcarrier input with an unbalanced shielded cable (RG-58 A/U typical) with BNC connectors. An input level of 1.5 Vp-p corresponds to a main carrier deviation of 7.5 kHz (6 kHz mono) by the MUX 2 subcarrier.

Where a control subcarrier is desired, a subcarrier frequency of 110 kHz (26 kHz for mono) is typically used. The modulated subcarrier may be generated internally in the remote control equipment as in the case of the Moseley MRC series. In any case, the control subcarrier is applied to the MUX 1 input on the PCL6010 transmitter at 1.5 Vp-p using BNC connectors on coaxial cable (RG-58 A/U typical). This signal will produce a main carrier deviation of 5 kHz (4 kHz mono) by the MUX 1 subcarrier.

The composite and multiplex inputs into the PCL6010 transmitter are wideband inputs. It is assumed that the equipment supplying signals to be fed into the transmitter contain the band limiting filters necessary to limit the signals to the spectrum for the intended use, i.e., 53 kHz for stereo composite, 110 kHz for control subcarrier (26 kHz ±3 mono), and 185 kHz (67 kHz ±1.10 mono) for secondary program audio.

If the external equipment generates any spurious signals, these signals will be accepted by the transmitter and passed to the receiver. Any spurious signals may cause intermodulation among the composite and subcarrier information, and may increase the occupied bandwidth to the extent that interference will be experienced by neighboring users in the STL band.

Figure 2-5 shows the connections for a mono setup. The same cautions and considerations apply as for composite. The mono input has a selectable low-pass filter for bandwidth limiting.

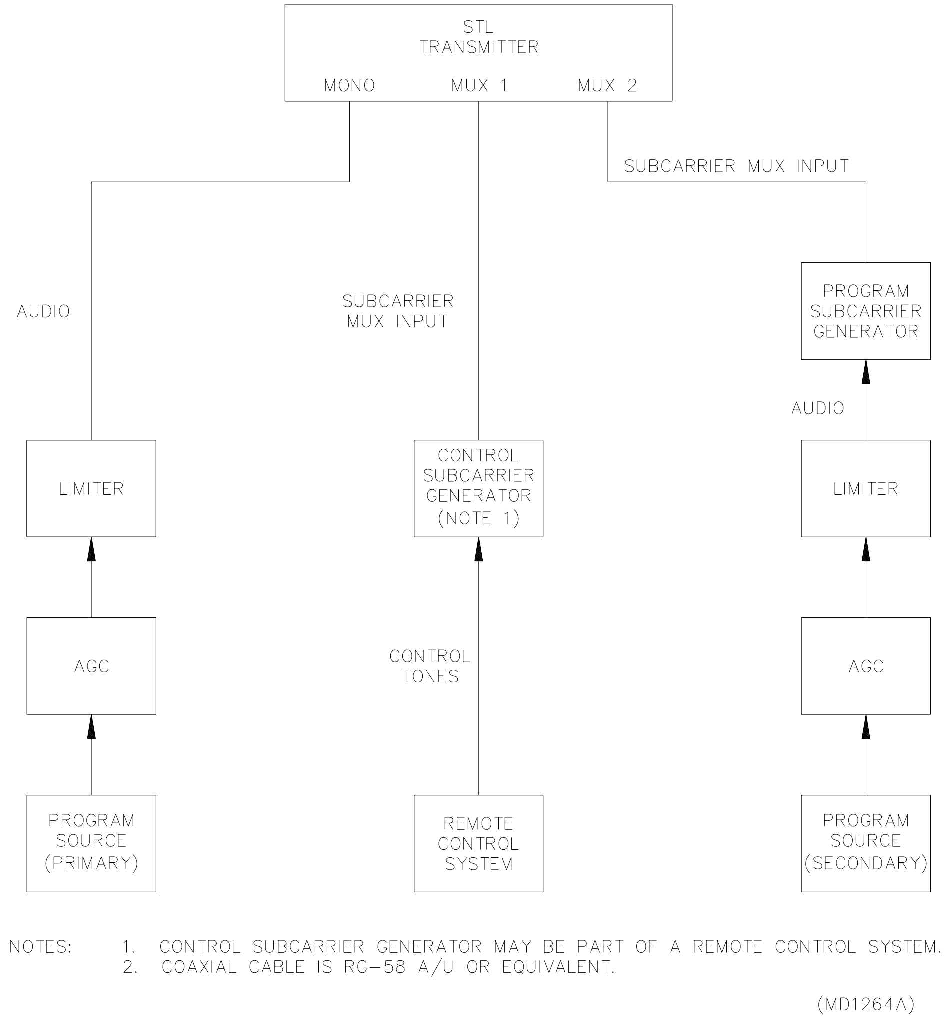


Figure 2-5
Transmitter PGM and MUX Interconnect — Mono

2.8 Program and Multiplex Installation — Receiver

At the outputs of the PCL6000 receivers, the baseband output of the IF demod is split and filtered into two bands. The audio outputs are from 30 Hz to approximately 85 kHz (15 kHz mono). The multiplex outputs are bandpass filtered to pass the frequency range of 100 kHz to 200 kHz (22 kHz to 85 kHz mono).

Figures 2-6 and 2-7 depict a typical interconnection of a PCL6000 receiver at the remote transmitter site. The unbalanced output (3.5 Vp-p composite, +10 dBm mono) is interconnected to the wideband input of the transmitter with coaxial cable (RG-58 A/U typical) with BNC connectors, or twisted shielded pair for mono.

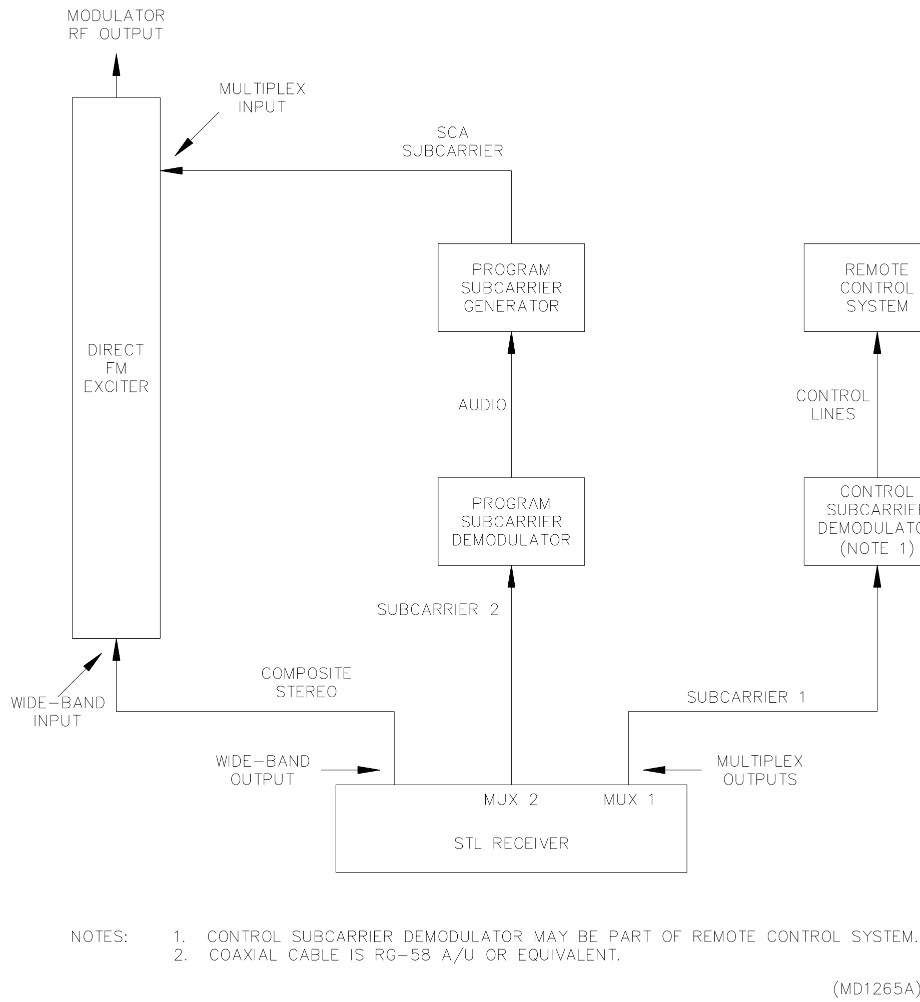


Figure 2-6
Receiver PGM and MUX Interconnect — Composite

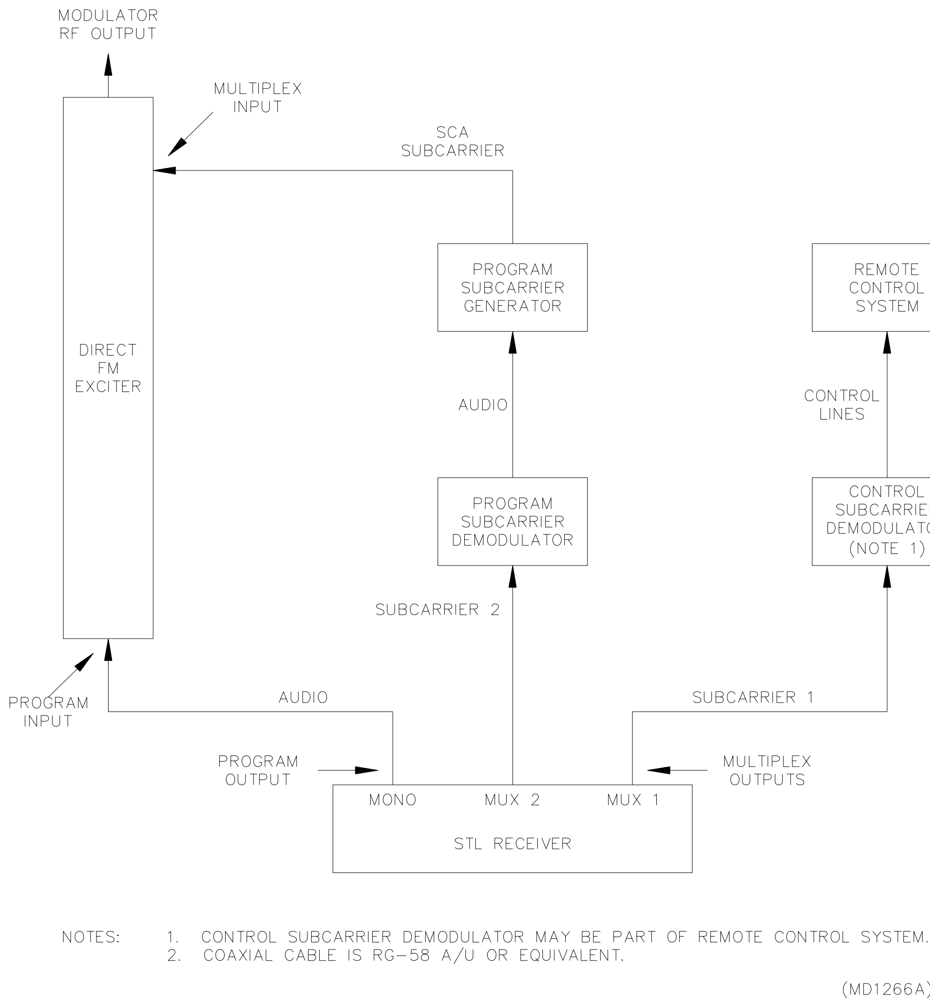


Figure 2-7
Receiver PGM and MUX Interconnect — Mono

The secondary program audio (on the STL 185 kHz subcarrier) is fed to the subcarrier demodulator. The baseband audio is passed to a subcarrier generator at 67 kHz, the normal SCA program carrier, which in turn is fed to the main transmitter multiplex input. The multiplex outputs may also be fed to the control subcarrier demodulator for use by the control system. Some control systems, such as the Moseley MRC series, have their own internal subcarrier demodulation capability, and an external demodulator is not required. Note that since both multiplex outputs contain the same 85 kHz to 200 kHz (20 kHz to 85 kHz mono) spectrum, the subcarrier demodulators are required to further filter the spectrum as required for their individual purposes.

2.9 Main/Standby Interconnect

The PCL6000 transmitter and receiver can be interfaced with other PCL6000, PCL606, PCL505, or PCL303 systems to form a redundant backup system that provides for automatic changeover between equipment in the event a detectable failure occurs. The Moseley model TPT-2 is used to accomplish automatic switchover for transmitters in all combinations. The model TPR-2 (Transfer Panel Receiver) is required on certain receiver combinations.

2.9.1 Transmitter Interconnect

When two transmitters are interconnected with a TPT-2 to form a main/standby pair, the composite and subcarrier generator output is routed to each transmitter in parallel. The RF output of each transmitter is routed to the respective RF input on the TPT-2. The transmission cable to the antenna is connected to the antenna type N connector of the TPT-2. Figures 2-8 and 2-9 detail the interconnection of these signals. The remote connector between the transmitters and the TPT-2 should be wired as shown in Table 2-3. Section 2.10 gives pin assignments for for the Transmitter I/O Remote Connector.

NOTE

For proper operation with a TPT-2, both transmitter RADIATE/ STANDBY switches should be in the STANDBY position.

Table 2-3
Remote Connector Wiring Guide

TPT-2	PCL6010*		PCL606	PCL505	PCL303
	9-pin D	9-pin round			
A	J1-2	B	A10-J1-B	J1-B	J403-F
B	J1-4	D	A10-J1-D	J1-D	J403-C
C	J1-3	C	A10-J1-C	J1-C	J403-D
GND	J1-1	A	A10-J1-A	J1-A	J403-A

∗ “9-pin D” and “9-pin round” refer to two types of rear panel TX RMT connectors. These are shown in Figure 2-13. The current standard is the 9-pin D connector. Older PCL6010’s have the 9-pin round connector. An appropriate mating connector is included with all units when shipped.

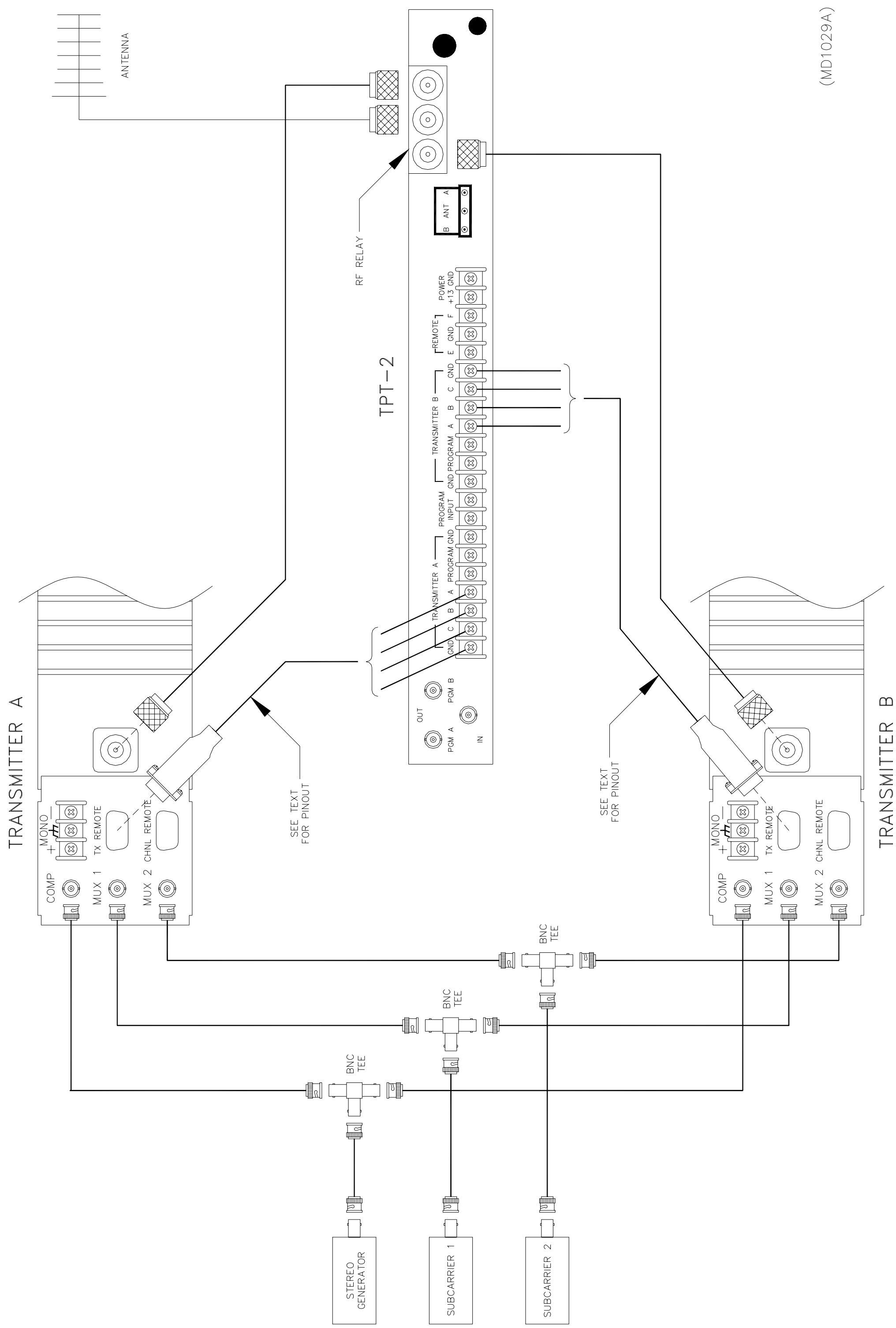


Figure 2-8
Main/Standby Transmitter Interconnect — Composite

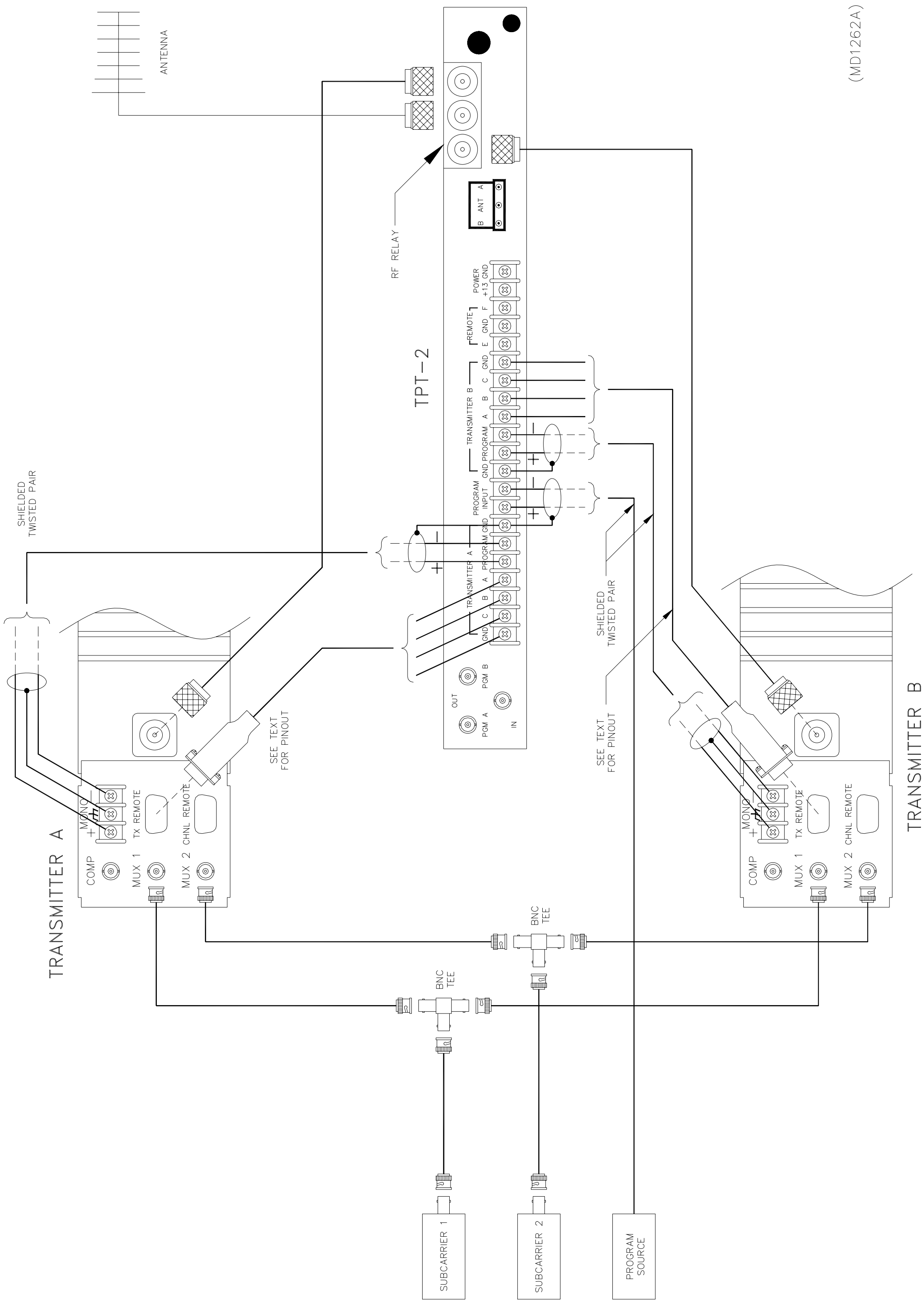


Figure 2-9
Main/Standby Transmitter Interconnect — Mono

2.9.2 Receiver Interconnect — Other STL Receivers

The PCL6000 receivers may be used with other Moseley STL receivers, such as the PCL505 and PCL303, may be used in a main/standby configuration, provided that a TPR-2 is used to perform the switching between the two receivers. A typical installation is detailed in Figure 2-10. Note that only one multiplex output can be used from the receivers; however, there are two parallel multiplex outputs on the TPR-2 to provide the control and secondary audio multiplex outputs.

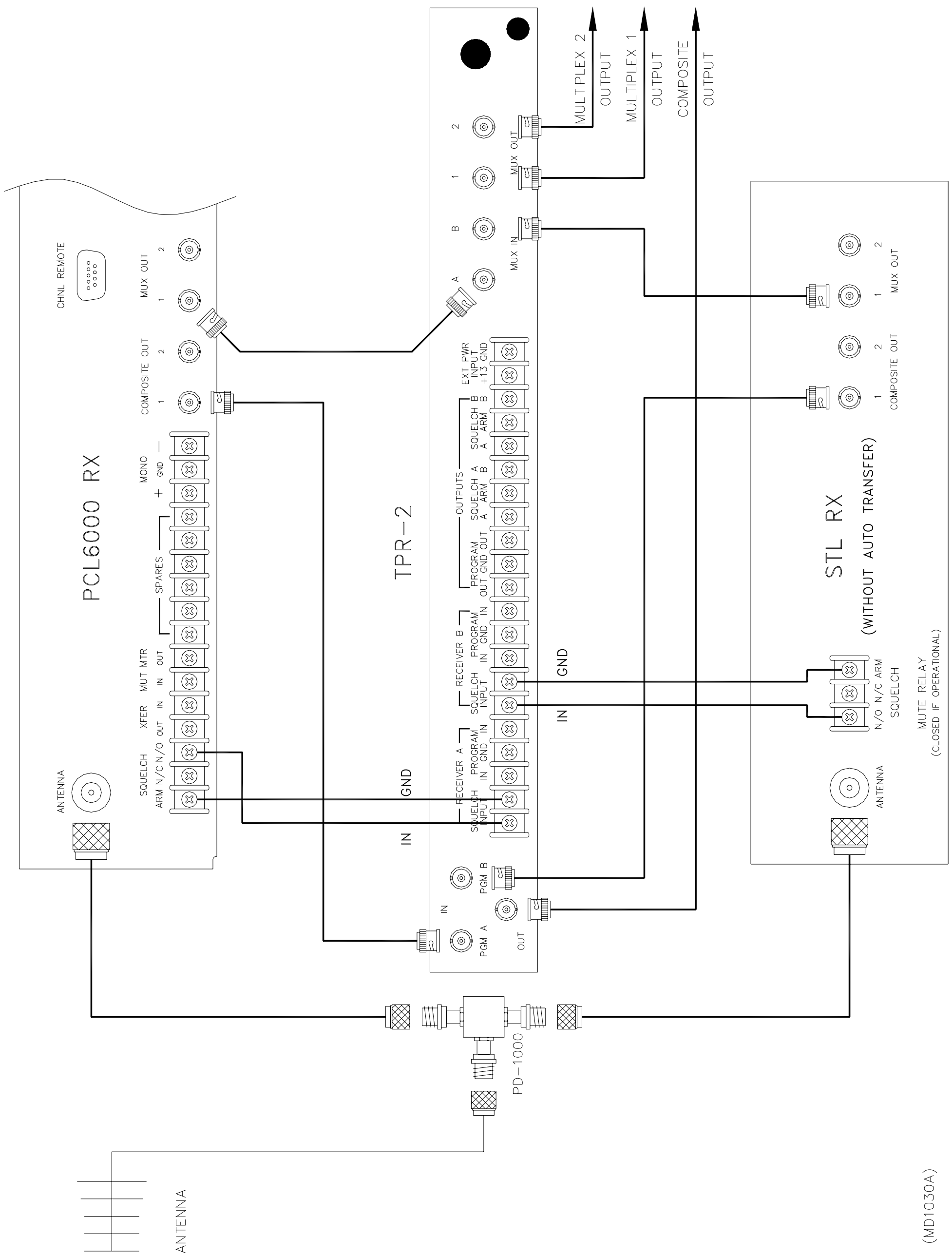


Figure 2-10
Main/Standby Receiver Interconnect — Other STL Receivers

2.9.3 Receiver Interconnect — PCL6000/606/600 Composite

PCL6000, PCL606, and PCL600 receivers used in a main/standby configuration can be interconnected to perform automatic switchover if detectable failure occurs in the on-line receivers. As shown in Figure 2-11, the antenna is routed to each receiver through a power divider such as the Moseley model PD-1000. The use of a power divider is recommended so that the impedance as seen by each receiver is approximately 50 ohms.

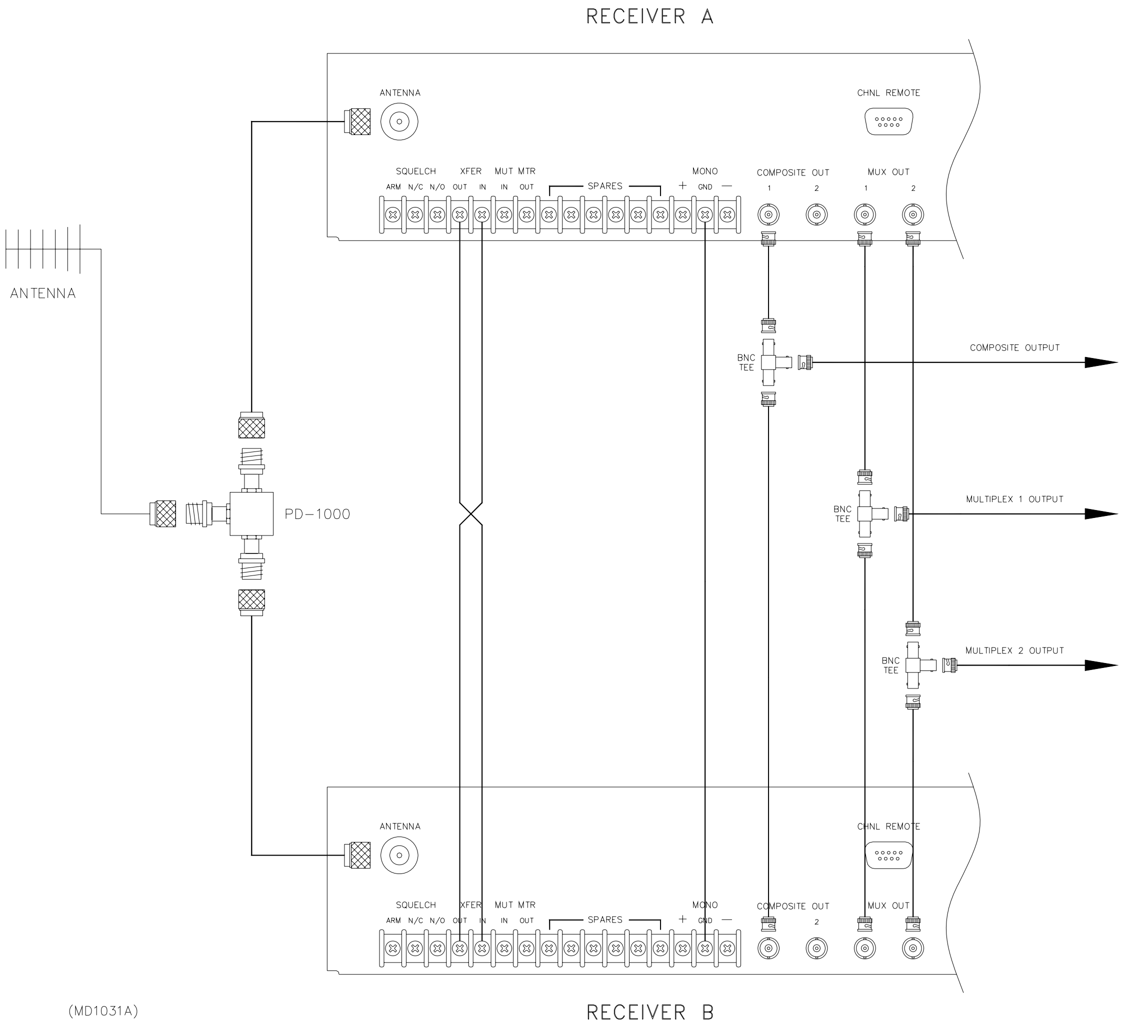


Figure 2-11
Main/Standby Receiver Interconnect — PCL6000 Composite

The composite and mux outputs are paralleled using a BNC Tee connector. This is permissible since the outputs are switched internal to the receiver. Only one of the receivers at a time will have any output. The interlock control is achieved by first interconnecting the ground (GND) on the two receivers. The XFR IN of each receiver is wired to XFR OUT of the other receiver. GND, XFR IN, and XFR OUT are located on the barrier strip on the rear of the receivers.

2.9.4 Receiver Interconnect — PCL6000/606/600 Mono

PCL6000, PCL606, and PCL600 receivers used in a main/standby configuration can be interconnected to perform automatic switchover if a detectable failure occurs in the on-line receivers. As shown in Figure 2-12, the antenna is routed to each receiver through a power divider such as the Moseley model PD-1000. The use of a power divider is recommended so that the impedance as seen by each receiver is approximately 50 ohms.

The mono and mux outputs are paralleled using a BNC Tee connector. This is permissible since the mono and multiplex outputs are switched internal to the receiver. Only one of the receivers at a time will have any output. The interlock control is achieved by first interconnecting the ground (GND) on the two receivers. Then, XFR IN of each receiver is wired to XFR OUT of the other receiver. GND, XFR IN, and XFR OUT are located on the barrier strip on the rear of the receivers.

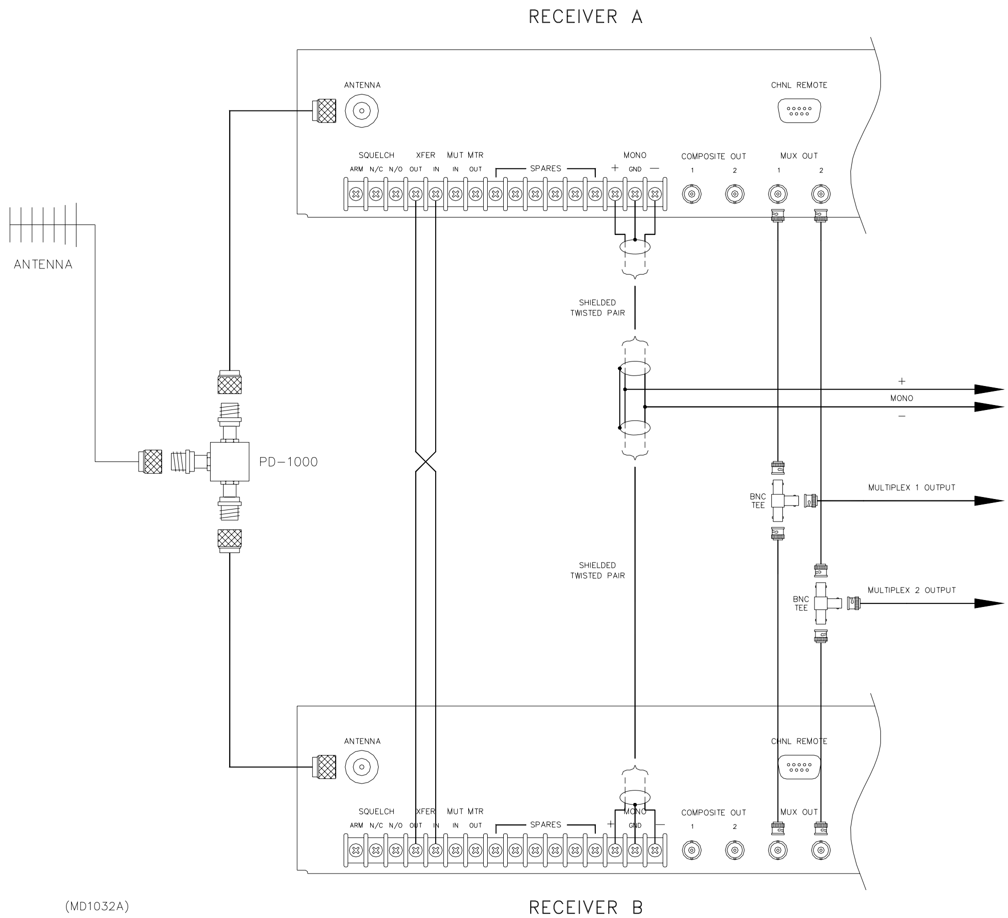


Figure 2-12
Main/Standby Receiver Interconnect — PCL6000 Mono

2.10 Remote Control of the STL Transmitter

The PCL6010 transmitter has been designed to be operated by remote control. Radiate/standby control capability, as well as metering outputs for power and AFC, are built in. Figure 2-13 shows the back panel I/O connector schematic that is required for remote control interface with the transmitter. Figure 2-13a is the pin-out for revision A transmitters using the circular 9-pin connector. Figure 2-13b is the pin-out for revision B and later transmitters using the 9-pin D (female) connector.

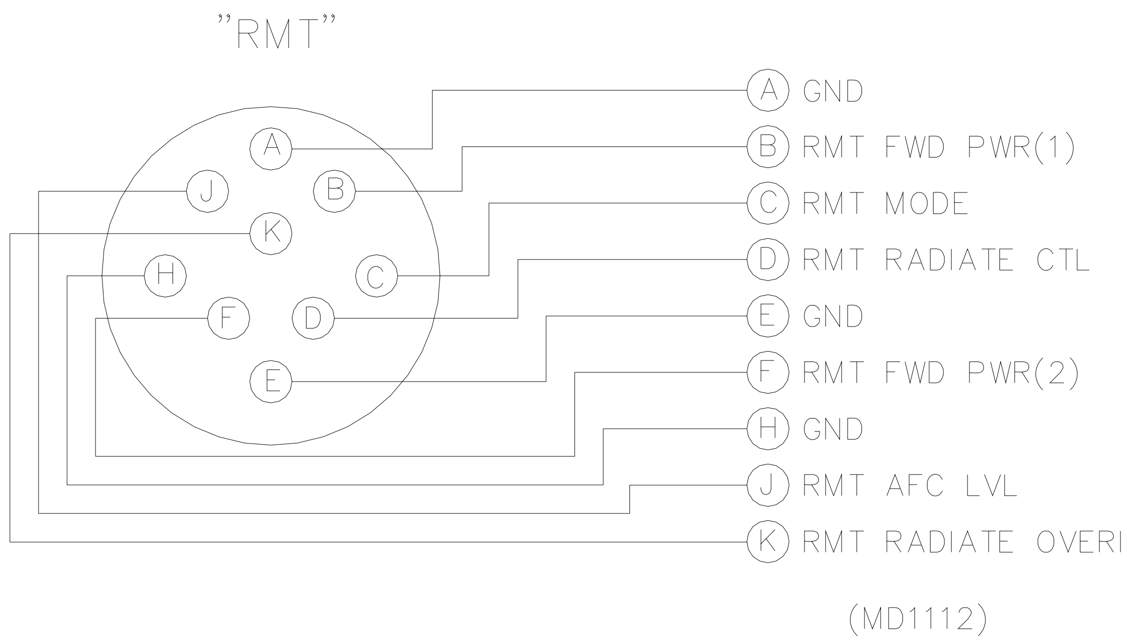


Figure 2-13a
Transmitter I/O Remote Connector Pin-Out (Rev. A)

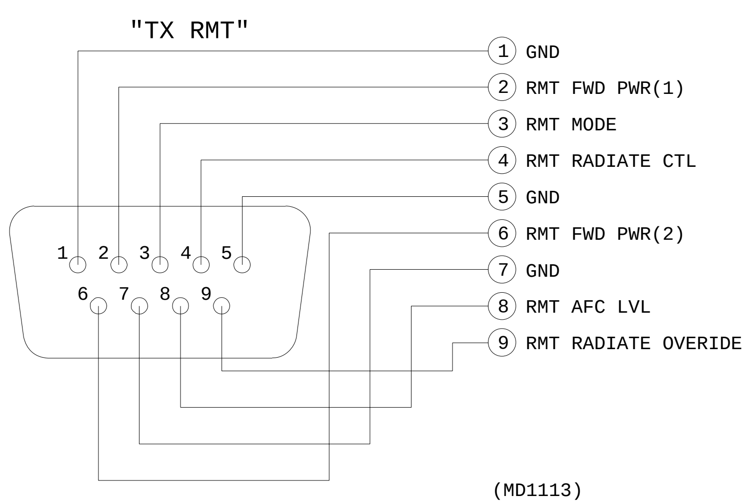


Figure 2-13b
Transmitter I/O Remote Connector Pin-Out (Rev. B or Later)

2.11 Multichannel Remote Interconnect (Option)

The PCL6000MC (Multichannel) is equipped with a CHANNEL CONTROL connector located on the back panel of both transmitter and receiver. The 9-pin D (male) connector pin-out is shown in Figure 2-14.

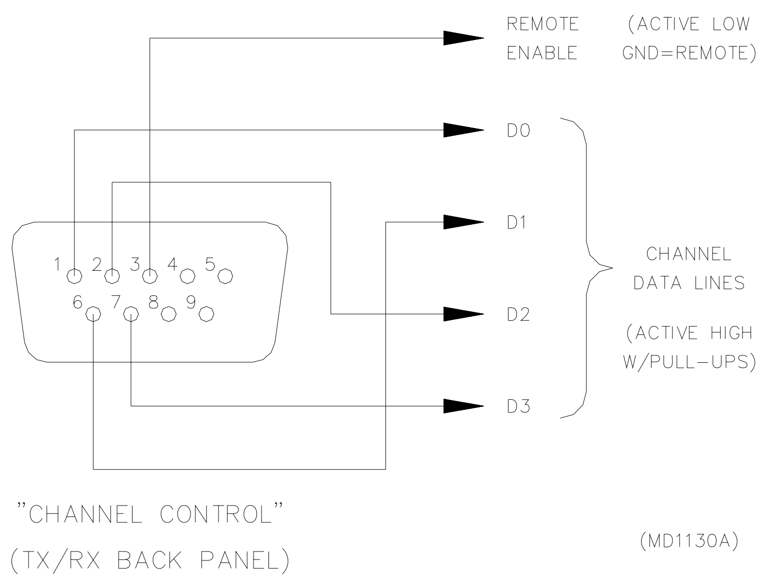


Figure 2-14
Transmitter Channel Control Connector Pin-Out

The REMOTE ENABLE line requires a contact closure to GND or logic level 0 (low) to enable the system for remote operation. The remote logic is ACTIVE HIGH with internal pull-up resistors and follows a standard BCD input standard utilizing contact closure or TTL logic levels. Table 2-4 shows the truth table for channel selection.

Complete operating instructions for the Multichannel System are found in Section 3.

Table 2-4
Channel Control Remote Interface Logic

REM ENABLE	D3	D2	D1	D0	CHANNEL
x	x	x	x	x	0
x	x	x	x	o	1
x	x	x	o	x	2
x	x	x	o	o	3
x	x	o	x	x	4
x	x	o	x	o	5
x	x	o	o	x	6
x	x	o	o	o	7
x	o	x	x	x	8
x	o	x	x	o	9
x	o	x	o	x	10
x	o	x	o	o	11
x	o	o	x	x	12
x	o	o	x	o	13
x	o	o	o	x	14
x	o	o	o	o	15

o = open circuit; x = gnd contact closure

3 Operation

3.1 Introduction

This section describes the controls and adjustments of a PCL6000 system that the user will encounter in normal operation and initial setup. Front panel metering and controls, as well as rear panel connectors, are shown and described. Standard single channel STL and Multichannel configurations are discussed and the appropriate panel diagrams can be found in the corresponding figures.

3.2 Transmitter Operational Controls

3.2.1 Transmitter Front Panel

The PCL6010 transmitter front panel (standard) is depicted in Figure 3-1. The meter functions and scales are described in Table 3-1. The top scale is calibrated in dB; below is a 0 to 25 linear scale. On the bottom is a center arc for relative indications. The meter is an absolute value peak-reading type with fast ballistics, since the purpose of the meter is to observe the peak values of modulation which affect the deviation of the transmitter.

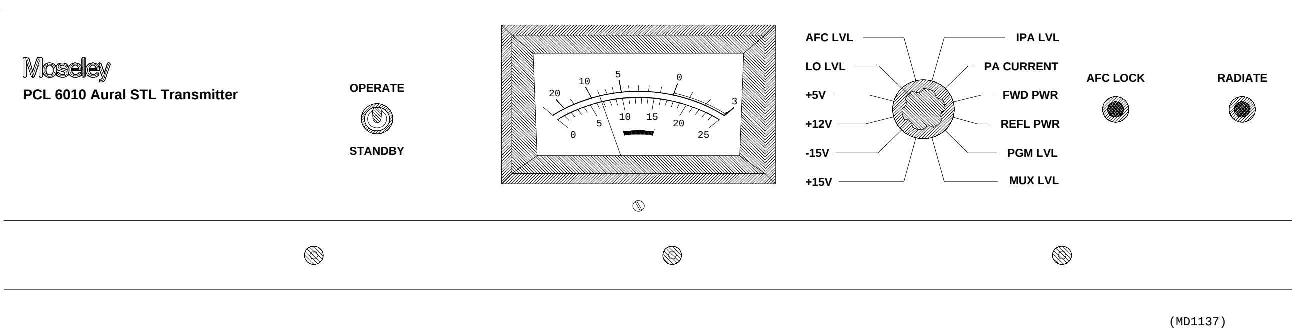


Figure 3-1
PCL6010 Transmitter Front Panel (Standard)

The two transmitter status LEDs are red/green bi-color LEDs. “AFC LOCK” is green when the FMO Synthesizer has achieved a lock condition. When “AFC LOCK” is red, it indicates that an unlock condition exists. This inhibits any radiation of RF power, resulting in “RADIATE” being red. When power is initially applied to the transmitter, it is normal for “AFC LOCK” to be red for several seconds.

“RADIATE” will be green when the transmitter is supplying RF power and red when not supplying RF power. “RADIATE” is controlled by the internal interlock controls, the RADIATE/STANDBY switch, and any external logic associated with main/standby operation.

The OPERATE/STANDBY switch functions as an on/off switch for the RF power output. In the OPERATE position, the RF power will be on, provided all of the internal interlocks are enabled. In

the STANDBY position, transmitter operation is controlled by external switching control and the internal interlocks.

Table 3-1
Transmitter Meter Functions and Scales

Function	Scale	Units	Notes
FWD PWR	dB	dB	RFA Forward Power in dB 0 dB = 100% power output
PGM LVL	dB	dB	Peak Program Meter 0 dB = 3.5 V_{p-p} @ 100% modulation
MUX LVL	Linear	kHz	Subcarrier deviation
REFL PWR	dB	dB	RFA Reflected Power in dB 0 dB = 100% reflected power -10 dB to -20 dB = safe
AFC LVL	Center Arc	Relative	AFC voltage (relative level–calibrated to center)
LO LVL	Center Arc	Relative	Local Oscillator (relative level–calibrated to center)
IPA LVL	Center Arc	Relative	Intermediate Power Amplifier (relative level–calibrated to center)
PA CURR	Linear	X 0.1 Amps	RFA final stage current
+5 V	Linear	Volts	Power Supply
+12 V	Linear	Volts	RFA supply, STBY = 1.5 VDC
+15 V	Linear	Volts	Power Supply
-15 V	Linear	Volts	Power Supply

3.2.2 Transmitter Rear Panel

The PCL6010 transmitter rear panel (standard AC power) is depicted in Figure 3-2. All of the program inputs (COMP/MONO) and MUX inputs are shown. The RF power output is a type N connector. TX REMOTE is used for external remote operation and standby/transfer interconnections. CHNL REMOTE is used for the Multichannel option. All of the necessary interconnections are found in Section 2. The fused AC input is line voltage programmable (see Figure 2-1).

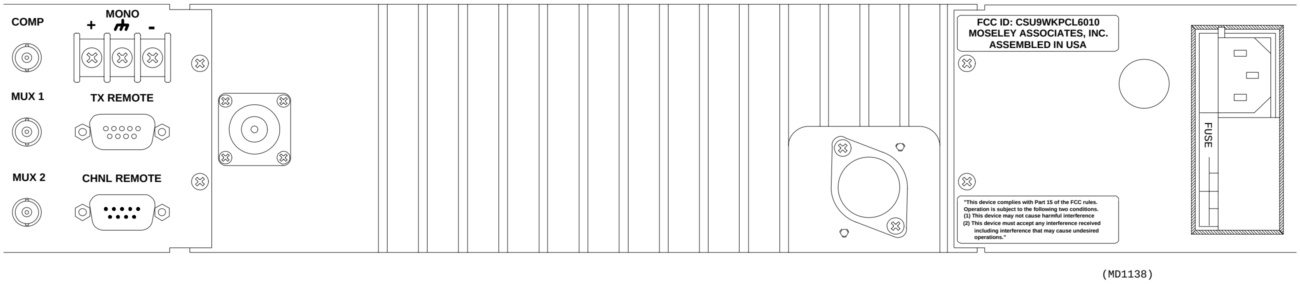


Figure 3-2
PCL6010 Transmitter Rear Panel

The PCL6010 transmitter rear panel (DC power option) is depicted in Figure 3-3. The DC input panel is marked in the factory for the DC input voltage, the internal ground configuration (NEG GND for positive DC input, ISO GND for negative or positive DC input), and fuse rating. See Section 4.2 for further technical information concerning the internal DC configuration.

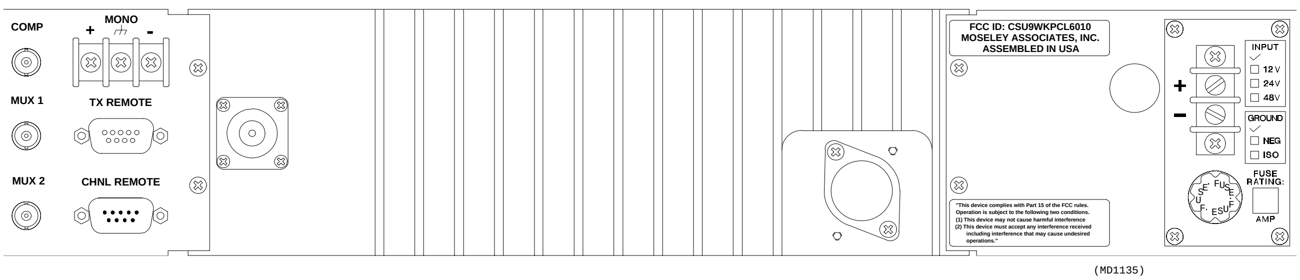


Figure 3-3
PCL6010 Transmitter Rear Panel (DC Option)

3.2.3 Multichannel Transmitter Operation

The Multichannel transmitter is preprogrammed for up to 16 channels of operation. The frequencies are predetermined by the customer and are factory set at time of manufacture. The PCL6010 transmitter front panel for the Multichannel option is depicted in Figure 3-4. The front panel display indicates the CHANNEL number that is currently active. A label on the rear panel lists the particular channel assignment frequencies. The front panel SELECT knob enables the user to change channels as necessary. The transmitter and receiver are matched with respect to channel assignment.

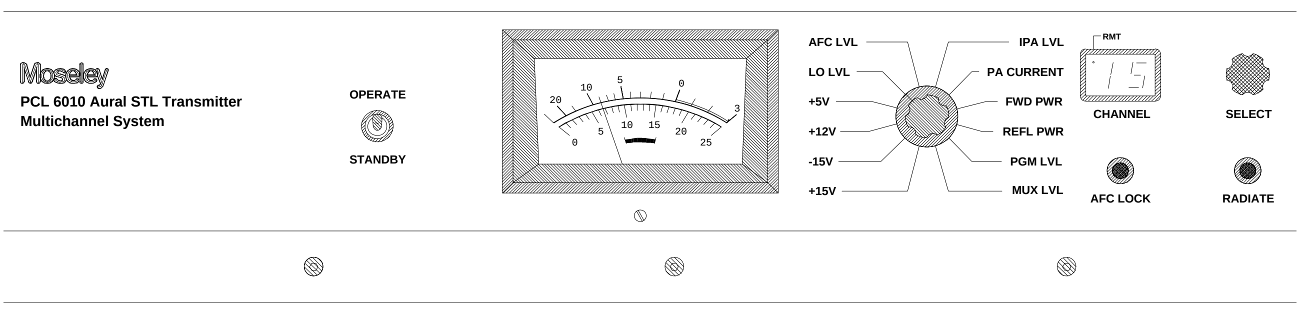


Figure 3-4
PCL6010 Transmitter Front Panel (Multichannel Option)

3.2.3.1 User Programmable "CHANNEL 0"

CHANNEL 0 is provided as a user-programmable channel for backup or testing purposes. This channel is set in the factory to duplicate CHANNEL 1. To set a new channel frequency, see section 5.3 (Alignment Procedures) or contact the Moseley Technical Services Department.

3.2.3.2 Remote Control Operation

The channel selection function of the Multichannel transmitter can be accessed via the back panel CHNL CONTROL connector. The schematic diagram of the 9-pin D connector and the required interface logic is shown in Figure 2-14 and Table 2-3. Additionally, the 5 position INTERNAL REMOTE dip switch (SW6) on the Channel Control board must have all switches in the "OPEN" or "1" position for proper remote control operation.

The front panel CHANNEL display will indicate the current remote control state of the transmitter with a red light in the upper left corner (RMT). The displayed channel number represents the actual channel the transmitter is operating in. The SELECT knob will have no effect on the transmitter in this mode. But the position of the SELECT knob retains its memory. Changing the knob position will change the channel that the transmitter will return to if the REMOTE ENABLE is disabled.

3.2.3.3 Front Panel Control "LOCKOUT" Operation

To prevent unauthorized or accidental changing of the channel via the SELECT knob, the front panel can be "locked out" by programming the 5 position INTERNAL REMOTE dip switch (SW6) on the Channel Control board. This switch emulates the remote control function internally and the unit will appear to be in remote control operation. Switching out the INT RMT ENABLE (S6) will return the transmitter to front panel control.

3.3 Receiver Operational Controls

3.3.1 Receiver Front Panel

The operation of the receiver front panel controls is very similar to the transmitter controls. Figures 3-5, 3-6, and 3-7 show the PCL6020, PCL6030, and PCL6060 receiver front panels (standard). The meter functions and scales are described in Table 3-2 (below). The top scale is calibrated in dB, followed by a four-decade logarithmic scale, below which is a 0 to 25 linear scale. On the bottom is a center arc for relative indications. The meter is an absolute value peak-reading type with fast ballistics, since the purpose of the meter is to observe the peak values of program material.

Three bi-color status LEDs indicate the operational status of the receiver. "SIGNAL" is green when there is sufficient RF signal to exceed a user-established threshold of RF signal that correlates to the minimum SNR that is acceptable to the user. When "SIGNAL" is red, there is insufficient signal to meet the minimum SNR requirements and the receiver is placed in a non-operating muted condition, which is indicated when "OPERATE" is red. When the receiver is operating properly, "OPERATE" is green. "AFC LOCK" indicates the condition of the synthesized second LO. It is green when the PLL is locked.

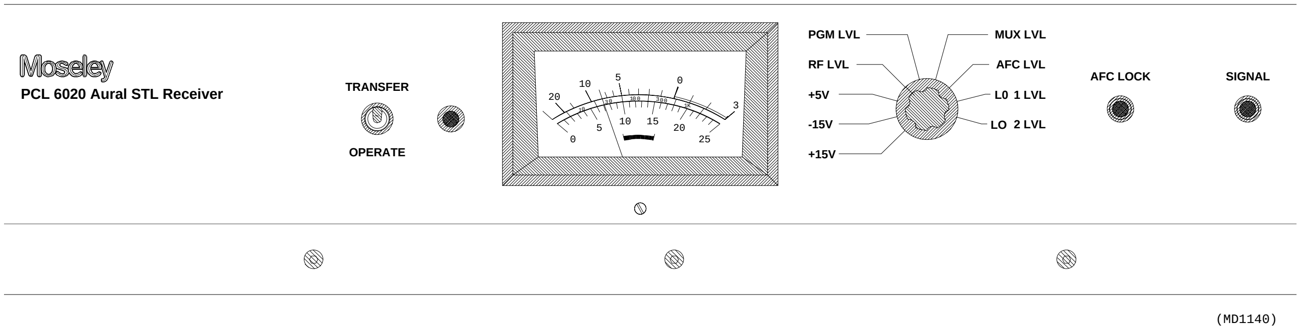


Figure 3-5
PCL6020 Receiver Front Panel (Standard)

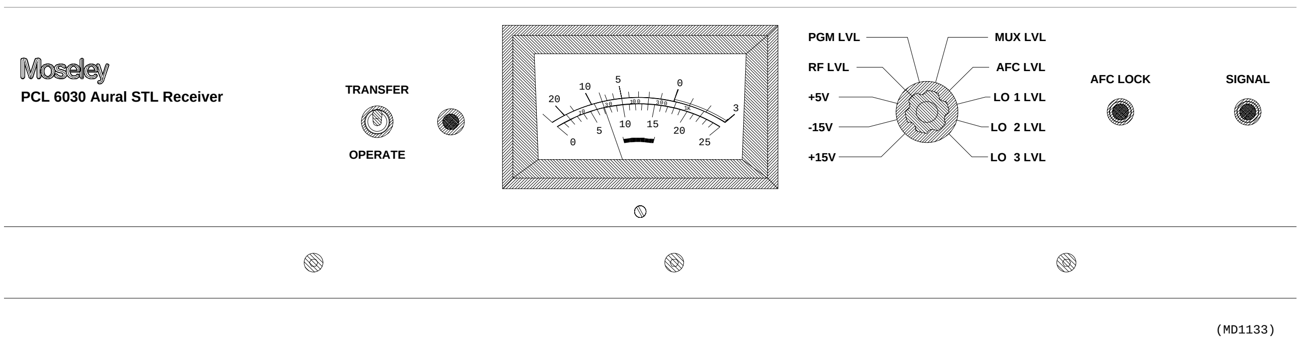


Figure 3-6
PCL6030 Receiver Front Panel (Standard)

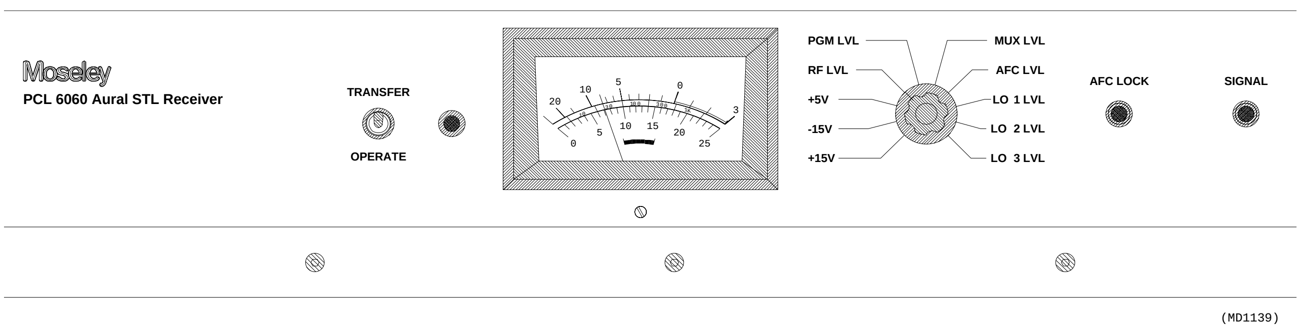


Figure 3-7
PCL6060 Receiver Front Panel (Standard)

Table 3-2 Receiver Meter Functions and Scales

Function	Scale	Units	Notes
RF LVL	Logarithmic	Microvolts	RF signal level at receiver input
LO1 LVL	Center Arc	Relative	First Local Oscillator (relative level–calibrated to center)
LO2 LVL	Center Arc	Relative	Second Local Oscillator (relative level–calibrated to center)
LO3 LVL	Center Arc	Relative	PCL6030/6060 ONLY Third Local Oscillator (relative level–calibrated to center)
PGM LVL	dB	dB	Peak program meter 0 dB = 3.5 $V_{p\text{-}p}$ @ 100% modulation
MUX LVL	Linear	kHz	Subcarrier deviation
AFC LVL	Center Arc	Relative	AFC voltage (relative level–calibrated to center)
+5 V	Linear	Volts	Power Supply
+15 V	Linear	Volts	Power Supply
-15 V	Linear	Volts	Power Supply

Figure 3-8 depicts the basic shape of the SNR curve with and without high-level signals in the band. It should be emphasized that it is not necessarily only high-level adjacent channels that can cause interference. There are many combinations of signals that can give rise to intermodulation distortion, which will cause the resultant product to fall within the desired passband.

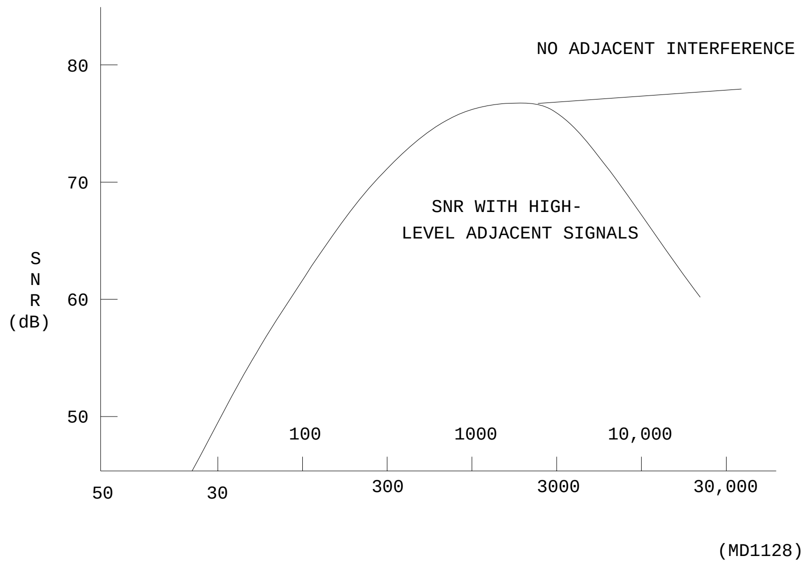


Figure 3-8 Typical SNR Curves

3.3.2 Receiver Rear Panel

The PCL6000 receiver rear panel (standard AC power) is depicted in Figure 3-9. All of the program outputs (COMP/MONO) and MUX outputs are shown. The RF signal input is a type N connector. The other functions on the barrier strip panel are used for standby/transfer interconnections. CHNL REMOTE is used for the Multichannel option. All of the necessary interconnections are found in Section 2. The fused AC input is line voltage programmable (see Figure 2-1).

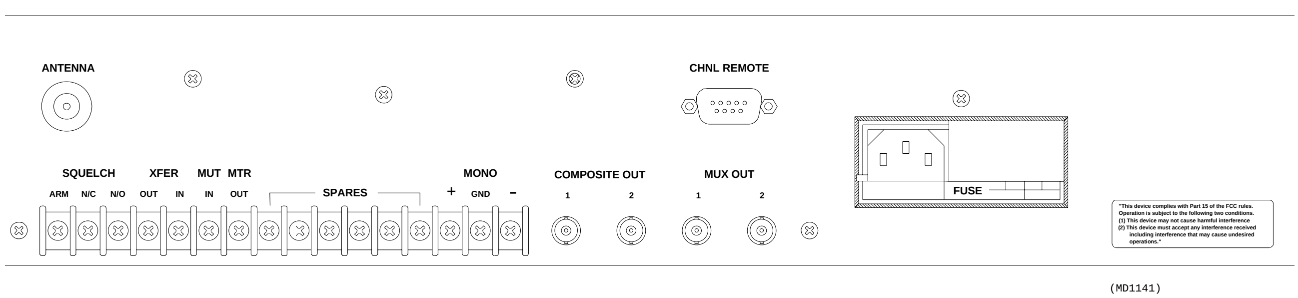
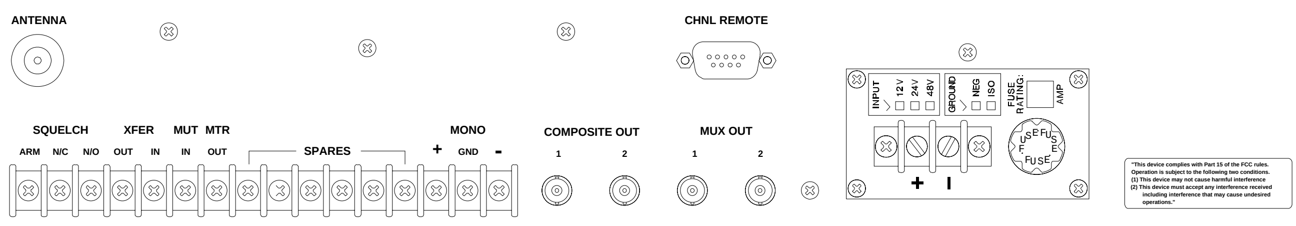


Figure 3-9
PCL6000 Receiver Rear Panel

The PCL6000 receiver rear panel (DC power option) is depicted in Figure 3-10. The DC input panel is marked in the factory for the DC input voltage, the internal ground configuration (NEG GND for positive DC input, ISO GND for negative or positive DC input), and fuse rating. See Section 4.3 for further technical information concerning the internal DC configuration.

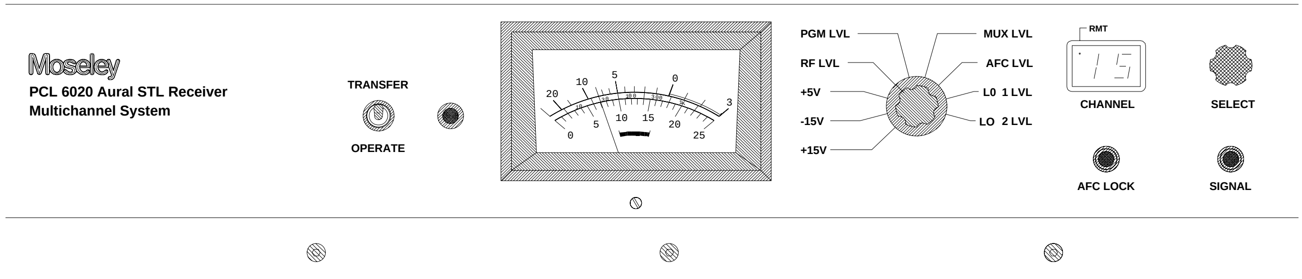


(MD1136)

Figure 3-10
PCL6000 Receiver Rear Panel (DC Option)

3.3.3 Multichannel Receiver Operation

The Multichannel receiver is preprogrammed for up to 16 channels of operation. The frequencies are predetermined by the customer and are factory set at time of manufacture. The PCL6020 receiver front panel for the Multichannel option is depicted in Figure 3-11. The front panel display indicates the CHANNEL number that is currently active. A label on the rear panel lists the particular channel assignment frequencies. The front panel SELECT knob enables the user to change channels as necessary. The transmitter and receiver are matched with respect to channel assignment.



(MD1134)

Figure 3-11
PCL6020 Receiver Front Panel (Multichannel Option)

3.3.3.1 User Programmable “CHANNEL 0”

CHANNEL 0 is provided as a user-programmable channel for backup or testing purposes. This channel is set in the factory to duplicate CHANNEL 1. To set a new channel frequency, see Section 5.3 (Alignment Procedures) or contact the Moseley Technical Services Department.

3.3.3.2 Remote Control Operation

The channel selection function of the Multichannel receiver can be accessed via the back panel connector marked “CHNL REMOTE”. The schematic diagram of the 9-pin D connector and the required interface logic is shown in Figure 2-14 and Table 2-3. Additionally, the 5 position INTERNAL REMOTE dip switch (SW6) on the Channel Control board must have all switches in the “OPEN” or “1” position for proper remote control operation.

The front panel CHANNEL display will indicate the current remote control state of the transmitter with a red light in the upper left corner (RMT). The displayed channel number represents the

actual channel the transmitter is operating in. The SELECT knob will have no effect on the transmitter in this mode. But the position of the SELECT knob retains its memory. Changing the knob position will change the channel the transmitter will return to if the REMOTE ENABLE line is disabled.

3.3.3.3 Front Panel Control “LOCKOUT” Operation

To prevent unauthorized or accidental changing of the channel via the SELECT knob, the front panel can be “locked out” by programming the 5 position INTERNAL REMOTE dip switch (SW6) on the Channel Control board. This switch emulates the remote control function internally and the unit will appear to be in remote control operation. Switching out the INT RMT ENABLE (S6) will return the receiver to front panel control.

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4 Module Characteristics

4.1 Introduction

This section provides theory of operation for the PCL6000 modules. Please refer to the listed schematic and assembly drawings for the receiver configuration (PCL6020/6030/6060), frequency band of operation (950, 450, 330, or 220 MHz, or 1.7 GHz), and Multichannel Option that applies to your system. Due to the many different system configurations, your particular drawing package has been supplied with the manual.

Figure numbers for referenced drawings can be found in the Table of Contents at the beginning of Section 7, Schematic and Assembly Drawings.

4.2 Transmitter Theory of Operation

4.2.1 Transmitter Audio/Power Supply

4.2.1.1 Power Supply (AC)

The power supply consists of an AC power connector (P1), transformer, rectifier (CR1), capacitive filters (C4, C5), and fixed linear regulators (VR1, VR2, VR3, VR4). The power supply has four output voltages: +15, -15, +5, and -12 VDC. The RFA supply is adjustable (R6) and factory set to +12.5 VDC when the transmitter is radiating. This voltage is reduced to +1.5 VDC if the AFC loses lock or if the transmitter is placed in STANDBY (see section 4.2.1.3). The rectifier and regulator for the +12.5 VDC supply are mounted on the RFA heat sink. Capacitive ripple filters C6, C7, C8 are mounted on the board and accessed through connector P2. The regulated -12 VDC is used to power the crystal ovens for the 1st LO and FMO reference oscillator crystals.

WARNING

Failure to ground the third lead of the input power cord may result in hazardous shocks to personnel.

The AC power connector includes an RF filter. The transformer primary windings support the four selectable input voltage ranges (100, 120, 220, and 240 VAC). Operating voltage is selected by programming the line filter/fuse holder on the rear panel as described in Section 2.2.1, AC Line Voltage Selection.

4.2.1.2 Radiate Control Logic

The Radiate Control Logic circuitry consists of Q3, S1, and U1. This circuit will allow the transmitter to radiate when the following conditions are simultaneously met:

1. The OPERATE/STANDBY switch (S1) is in the OPERATE position, or the OPERATE/STANDBY switch (S1) is in the STANDBY position and pin 4 (D) of the transmitter I/O panel remote connector (RMT RAD) is at ground potential (see Figure 2-13).
2. The AFC LOCK signal from the RF module (P4-2) is HIGH (+5 VDC).
3. Pin 9 (K) of the back-panel remote connector (RMT OVRD) is floating (not connected to ground). This will appear as +5 VDC on this pin (see Figure 2-13).

When all of the above conditions occur, the base of Q3 will go from +3 V to 0 V, enabling the +12.5 VDC power supply. The IPA and RFA will operate thus allowing the transmitter to radiate.

The OPERATE/STANDBY switch (S1) on the front panel is a double-pole, double-throw switch used to activate logic circuits within the transmitter and is connected through the harness to pin 3 (C) of the back-panel remote connector (RMT MODE) for remote indication of the OPERATE/STANDBY mode.

For ±12, ±24, and ±48 VDC supply configuration, Q3 provides a logic level output to switch the internal DC supply on and off according to the RADIATE status. The schematic references this option.

4.2.1.3 PA Current Signal Conditioner

The voltage drop appearing across the PA current sampling resistor (in the RFA module) is presented to the Audio/Power Supply board on P3-9 and P3-10. Amplifier U15 and FET Q1 provide a current sample for the meter that is independent of the RFA supply voltage. The current-to-voltage conversion is different for the various frequency bands.

220–950 MHz	0.18 VDC per Ampere
1.7 GHz	0.16 VDC per Ampere

The sample voltage is measured at the input terminals of the RFA module.

4.2.1.4 Metering and Status

The Metering Functions are selected by the front panel meter switch (S2) and are calibrated by potentiometers R151 (+15V), R153 (-15V), R155 (+12V), R157 (+5V), R166 (LO1), R165 (AFC LVL), R164 (IPA LVL), R163 (PA CURRENT), R162 (FWD PWR), R161 (REFL PWR), R201 (COMP PGM MTRG), R202 (MONO PGM MTRG), R203 (DIG PGM MTRG). The signals are processed by absolute value amplifier and peak detector U11. This output is followed by a buffer and meter ballistics amplifier U12. R131 (METER ZERO) is used to electrically zero the meter. R286 (METER BALLISTICS) is used to adjust the meter acceleration and ballistics response.

The forward power sample from the RFA enters the Audio/Power Supply board on P3-1 and is amplified by U13b. The output is fed to the meter circuit for front panel meter display. This output also appears on P4-9 (RMT-FWD1) for remote metering and hot standby purposes. Output P4-10 (RMT-FWD2) is available after the TPT THRESHOLD (R138) adjustment to be used in conjunction with the MOSELEY Transmitter Transfer Panel (TPT-2) to optimize the switchover point in a hot standby configuration. The output of U13b is also fed to differential amplifier U14a, where it is used to control the front panel radiate status indicator (CR21).

The reflected power sample from the RFA enters the board on P3-2 and is amplified by U13a to a usable level for metering.

U10b buffers the RF module AFC LVL signal (P5-1) for remote metering (RMT-AFC) that appears on pin 8 (J) of the back panel remote connector.

U14b is an LED driver for the AFC LOCK status indicator (CR20) on the front panel; the LED is red when the AFC is out of lock, and green when locked.

4.2.1.5 Audio Processor

The audio processor supports either monaural or composite operation. The balanced monaural input is converted to an unbalanced signal with the active balanced input amplifier (U9 and U8). Jumper E6 enables the user to optimize the network for different nominal input impedance and levels (see the table in the schematic). The second half of U8 is an active 75ms pre-emphasis network (enabled by jumper E5). F1 (R77) and F2 (R78) adjust the low and high frequency break points for optimum frequency response. The monaural signal is routed through a seven pole active filter (U7, U6, and U5) with 15 kHz cut-off. Adjustments FA (R76), FB (R75), and FC (R49) are used to tune the roll-off of the filter and align the phase linearity of a dual-mono STL link. LF TILT (R47) compensates for low frequency tilt caused by IF filter non-linearities. LPF GAIN (R45) sets the overall monaural low pass filter unity gain. Jumper E4 selects the active filter to be in or out of the monaural audio processing path.

Jumper E3 selects either the monaural or composite input to the audio processor. U3a is a non-inverting amplifier to set the program levels of the audio processor for all configurations: MONO (R199), COMPOSITE (R28), and DIGITAL (R28). The MUX inputs are summed into U3b and the levels are independently adjustable: MUX1 (R29) and MUX2 (R40). The PROGRAM and MUX signals are summed into U2b and both levels are routed to the metering circuits at this point. U2a is an inverter which is selectable (E2) to match the STL link audio phase when using different receivers. The baseband output is at J1 which is applied to the transmitter RF module.

4.2.2 Transmitter RF Module

4.2.2.1 FMO Synthesizer

The FMO Synthesizer consists of three main subgroups: the RF group, the digital group, and the loop filter. The RF group includes the frequency modulated oscillator (FMO), buffer, reference oscillator, and low-pass filter. The digital group includes a dual modulus prescaler and an integrated PLL IC that provides multiple functions to be described later.

These three groups provide an RF signal source that has good short-term stability, low noise, and is tunable over a wide frequency range. Selecting the appropriate divide ratio synthesizes the crystal-controlled reference oscillator and ensures long-term stability.

The FMO consists of low-noise field effect transistor Q4 in an RF grounded base configuration. The drain of Q4 is connected to the resonant circuit inductor and capacitors. The capacitance for this circuit is provided by C35, C40 and C41, as well as the three switching networks that control the capacitors C26, C30, and C34. The inductance consists of a stripline inductor on the PC board. Feedback to cause oscillation is from the drain to the source consisting of C40 and C41. The normal frequency range of the oscillator is 60 to 80 MHz.

If the Multichannel option is being utilized in the system, the modulation signal enters the RF module at J11-25 from the programmed compensation circuit located on the Channel Control board. The modulation gain varies at different frequency settings, therefore the gain must be compensated for. If the RF module is being used as a stand-alone, the modulation signal enters

the RF module at J1. The signal is then applied to CR12, which is a variable capacitance diode. CR12 is coupled to the resonant circuit by C39. R37 (VARICAP BIAS ADJUST) adjusts the bias on CR12 and is set for minimum modulation distortion, usually approximately -5 V. R33 (MODULATION ADJUST) adjusts the amount of modulation on the bias voltage applied to CR12. A 3.5 Vp-p input at J1 will produce 100% modulation (50 kHz deviation, composite).

The signal is buffered by U4 which drives the seven-section elliptical low-pass filter comprised of C55, L6, C56, C57, L7, C58, C59, L8, C60, and C61. This sharp cut-off filter attenuates the harmonics of the FMO. The output is buffered by the resistive attenuator (R78, R79, R80) to provide a level at the mixer of -6 dBm.

R48 is used to sample the FMO output as feedback for the high speed dual-modulus prescaler (U2). The prescaler divides the 70 MHz signal by 10 or 11, depending on the divide ratio selected by the integrated PLL chip (U1). This technique enables one divider IC to be used for small step sizes. The PLL chip contains programmable dividers (/N, /A, /R), a digital phase detector, modulus control logic, and lock detect circuitry to reduce chip count and increase reliability in synthesizer designs.

OSC1 is a temperature compensated crystal oscillator (TCXO) that provides a stable, low phase noise reference oscillator for the phase lock loop. The internal phase detector compares the VCO and reference oscillator inputs and delivers a series of pulses to the integrating loop filter.

Loop filter U3 is an integrating low-pass filter that removes most of the reference frequency component of the phase comparator output. It also provides DC gain to decrease the very low frequency noise of the FMO. Further filtering of the AFC voltage is then delivered to CR10 and CR11 through R30, closing the AFC loop. The frequency stability of the FMO is maintained by CR10 and CR11, which is attached to the stripline inductor through C62. A voltage generated by the AFC circuitry changes the capacitance of CR10 and CR11, which is also part of the tuning of the FMO resonant circuit. Depending upon which capacitors are switched into the resonant circuit—F1 (C34), F2 (C30), or FIX (C26)—the AFC level adjustment is used to place the phase-locked loop in the center of its operating control range. This is indicated by a nominal +7 VDC AFC level.

For Multichannel operation, different capacitors are switched in to maintain an AFC range between 5–9 VDC for different channel frequencies. These switching networks are labeled F1, F2, and FIX. A logic level of +5 VDC at the input of the buffers (Q3, Q2, Q1) will connect that corresponding capacitor into the resonant circuit. If the Multichannel option is being utilized in the system, these settings come from the Channel Control board's programmed inputs at J11-5, -18, -6, and switch S4 must be disabled (open circuit). If the RF module is being used as a stand-alone, switch S4 is used to switch in the required capacitors. In either case, green LED indicators CR6 (F1) and CR5 (F2) will light to indicate which setting is active. The FIX capacitor is normally used to band-switch to a frequency far removed from the initial setting.

The lock detect signal at U1-28 is a series of pulses at the step size rate (25 kHz) when the loop is locked. The low pass filter (R19 and C13) provide an average voltage at U3-5 of +5 VDC when the loop is locked. If the loop becomes unlocked, the average voltage drops to 2.5 VDC. This causes the output of comparator U3 to change state which lights the red LOSS OF LOCK LED on the module. Also, the voltage at FL2 drops from +5 to 0 VDC, causing the radiate control circuitry to put the transmitter in STANDBY.

The output frequency of the FMO is determined by the divider values programmed into the PLL chip U1. If the Multichannel option is being utilized in the system, these settings come from the Channel Control board's parallel inputs at J11, and the internal switches S1, S2, S3, and S4-1 must be disabled (S4-1 open circuit and S1,2,3 set to “F”). If the RF module is being used as a stand-alone, the frequency is set by the values of switches S1, S2, S3, and S4-1. The output frequency is determined by adding the resultant frequency values set by each switch. S4-1 is a

one bit switch that sets 64 MHz. S1, S2, and S3 are four-bit switches set to a hex value (0,1,2,3,4,5,6,7,8,9, A,B,C,D,E,F), where A–F corresponds to 10–15. The transmitter frequency example below illustrates the math.

Transmitter frequency example:

```
1st LO        =   1020.000   MHz

Carrier Freq  =  - 950.500

FMO Freq      =     70.500   MHz
```

```
SWITCH SETTINGS:    S4-1   1   X     64   =   64.000   MHz

                     S1    1   X      4   =    4.000

                     S2    A   X    .25   =    2.500

                     S3    0   X   .025   =    0.000

                                              70.500   MHz
```

(Note: See section 5.3.9 for changing the STL frequency in the field)

4.2.2.2 1st Local Oscillator (950 MHz/1.7 GHz)

The 1st LO signal is derived from crystal-controlled oscillator Q5. The fifth overtone crystal (Y1; 102.000 MHz for 950 MHz, 92 MHz for 1.7 GHz) is temperature stabilized by a 65°C proportionally controlled oven (HR1). Oscillator buffers Q6 and AR1 isolate the oscillator and amplify the signal, preventing frequency pulling when adjusting the multipliers.

The output of the buffer is doubled in an active push-push doubler. The single-ended input from the buffer is split into two out-of-phase voltages in T1 and applied to the bases of Q7 and Q8. The output of these two transistors is summed at their collectors.

The output of the doubler is tuned by C94 and L14 and is impedance matched to the step-recovery diode multiplier by C95 and C96. The diode self-bias current is determined by RT1. The step-recovery diode (CR14) forms the heart of a X5 multiplier (C98, C99, and the 12 nH printed inductor). The multiplier converts the input sinusoidal signal to a stream of impulses. These impulses are fed to an LC output circuit (L16 and C101) which is tuned to the desired output frequency. The three pole helical filter (FL10) is tuned to the LO output frequency (1020 MHz nominal for 950 MHz, 920 MHz nominal for 1.7 GHz). The output is terminated into a 3 dB attenuator, reducing the output power to that required by the 1st mixer and providing a wideband match for the filter. The undesired harmonics are suppressed at least 40 dB. The output power is between +5 and +9 dBm.

4.2.2.3 1st Local Oscillator (220 MHz)

The 1st LO signal is derived from crystal-controlled oscillator Q5. The fifth overtone crystal (Y1, 97.000 MHz nominal) is temperature stabilized by a 65°C proportionally controlled oven.

Oscillator buffers Q6 and AR1 isolate the oscillator and amplify the signal, preventing frequency pulling when adjusting the multipliers.

The output of the buffer is phase-shifted in T1 and applied to the base of Q7.

The output of the transistor is impedance-matched to the step-recovery diode multiplier by C95. The step-recovery diode (CR14) and the 12 nH printed inductor form a X3 multiplier. The multiplier converts the input sinusoidal signal to a stream of impulses. These impulses are fed to an LC output circuit (L16 and C101) which is tuned to the desired output frequency. The multiplier output is routed through an external three pole helical filter and is tuned to the LO output frequency (291 MHz nominal). The output is terminated into a 3 dB attenuator, reducing the output power to that required by the 1st mixer and providing a wideband match for the filter. The undesired harmonics are suppressed at least 40 dB. The output power is between +5 and +9 dBm.

4.2.2.4 1st Local Oscillator (330/450 MHz)

The 1st LO signal is derived from crystal-controlled oscillator Q5. The fifth overtone crystal (96.250 MHz nominal) is temperature stabilized by a 65°C proportionally controlled oven. Oscillator buffers Q6 and AR1 isolate the oscillator and amplify the signal, preventing frequency pulling when adjusting the multipliers.

The output of the buffer is doubled in an active push-push doubler. The single-ended input from the buffer is split into two out-of-phase voltages in T1 and applied to the bases of Q7 and Q8. The output of these two transistors is summed at their collectors.

The output of the doubler is tuned by C94 and L14 and is impedance matched to the step-recovery diode multiplier by C95 and C96. The diode self-bias current is determined by RT1. The step-recovery diode (CR14) forms the heart of a X2 multiplier (C98, C99, and the 12 nH printed inductor). The multiplier converts the input sinusoidal signal to a stream of impulses. These impulses are fed to an LC output circuit (L16 and C101) which is tuned to the desired output frequency. The multiplier output is routed through an external three pole helical filter and is tuned to the LO output frequency (385 MHz nominal). The output is terminated into a 3 dB attenuator, reducing the output power to that required by the 1st mixer and providing a wideband match for the filter. The undesired harmonics are suppressed at least 40 dB. The output power is between +5 and +9 dBm.

4.2.2.5 Up Converter Chain (950 MHz)

The Up Converter Chain consists of a mixer, high gain amplifier, and filters. The mixer (HY1) translates the FMO signal (60–80 MHz) up to the carrier frequency (950 MHz). The mixer is double-balanced for LO rejection and the conversion loss is 8 dB.

The Intermediate Power Amplifier (IPA) is a four stage broadband RF amplifier (AR2, AR3, AR4, AR5) with 30 dB of gain and an output power of +16 dBm. FL12 is a two-pole helical filter that prevents intermodulation in the IPA. FL11 is a three-pole helical filter that provides the necessary spurious rejection for the RF module. The output stage (AR5) operates in compression to minimize any changes in gain over a wide temperature range.

An output power detector (C124, CR16, R85, C125) is provided for the IPA. Relative power is detected and relayed to the Audio/Power Supply board. This voltage should be approximately 2 volts.

The output of the RF module is sent through an external three-pole helical filter before being applied to the RFA to further reduce unwanted spurious emissions (see system block diagram in Section 1).

4.2.2.6 Up Converter Chain (220–450 MHz)

The Up Converter Chain consists of a mixer, high gain amplifier, and filters. The mixer (HY1) translates the FMO signal (60–80 MHz) up to the carrier frequency. The mixer is double-balanced for LO rejection and the conversion loss is 8 dB.

The output of the mixer is sent to an external 3-pole helical filter and then routed back to the RF module IPA. The Intermediate Power Amplifier (IPA) is a four-stage broadband RF amplifier (AR2, AR3, AR4, AR5) with 30 dB of gain and an output power of +20 dBm. The output stage (AR5) operates in compression to minimize any changes in gain over a wide temperature range.

An output power detector (C124, CR16, R85, C125) is provided for the IPA. Relative power is detected and relayed to the Audio/Power Supply board for metering. This voltage should be approximately 2 to 3 volts.

The output of the RF module is sent through an external three-pole helical filter before being applied to the RFA to further reduce unwanted spurious emissions (see system block diagram in Section 1).

4.2.2.7 Up Converter Chain/Doubler Assembly (1.7 GHz)

The 1.7 GHz PCL6010 utilizes a doubler to achieve the carrier frequency, therefore the Upconverter is nearly identical to the 950 MHz band Up Converter. The Up Converter Chain consists of a mixer, high gain amplifier, and filters. The mixer (HY1) translates the FMO signal (60–80 MHz) up to the RF module output frequency (850 MHz). The mixer is double-balanced for LO rejection and the conversion loss is 8 dB.

The Intermediate Power Amplifier (IPA) is a four-stage broadband RF amplifier (AR2, AR3, AR4, AR5) with 30 dB of gain and an output power of +16 dBm. FL12 is a two-pole helical filter that prevents intermodulation in the IPA. FL11 is a three-pole helical filter that provides the necessary spurious rejection for the RF module. The output stage (AR5) operates in compression to minimize any changes in gain over a wide temperature range.

An output power detector (C124, CR16, R85, C125) is provided for the IPA. Relative power is detected and relayed to the Audio/Power Supply board. This voltage should be approximately 2 volts.

The output of the RF module is sent to the Doubler Assembly which multiplies the modulated signal (X2) to bring the carrier to the 850 MHz (nominal) operating frequency. The output of the doubler is filtered by an external 5-pole interdigital coupled resonator filter to select the appropriate harmonic before being applied to the RFA (see system block diagram in Section 1).

4.2.3 RF Amplifier

4.2.3.1 RF Amplifier (950 MHz)

The RF Amplifier module is a three-stage power amplifier designed to produce 6 watts nominal output power over the 890–960 MHz band when driven with a +16 dBm nominal input signal. The heart of the module is a high gain UHF power amplifier hybrid device (AR1) that exhibits excellent stability and ruggedness. AR1 provides 22 dB of gain that is factory-set in the transmitter for 6 watts by adjustment of R1. Field adjustment of R1 is not recommended since other design considerations will be compromised (i.e., DC power consumption, temperature stability, efficiency, etc.).

CAUTION

Power must be limited to +19 dBm (80 mW) or permanent damage to the module may result.

The PA current sample is derived across R2 plus any additional line losses to provide 0.18 volt/amp sensitivity at the RFA input terminals (C701 and C702). This sample is fed to the Audio/Power Supply board and a test point is provided for monitoring.

The seven-section low-pass filter following AR1 is realized in a semi-lumped configuration utilizing microstripline inductors, open-circuited stubs and lumped capacitors C8 and C9. The filter attenuates the harmonics of the final stage to better than -60 dBc per FCC requirements.

The dual-directional coupler is fabricated using stripline technology to provide high-directivity, therefore assuring accurate forward and reflected power sampling. Detectors CR1 and CR2 provide DC meter samples for reflected and forward power, respectively. These sample voltages are fed to the Audio/Power Supply board. The forward and reflected power sample is conditioned and fed to the meter for monitoring. Forward power voltage level at C721 is approximately 2.5 VDC for the nominal 10 watts output. Reflected power voltage level at C722 is approximately 2.5 VDC for the 100% reflected power.

The RFA supply bridge diode (CR101) and regulator (Q101) are mounted to the heat sink of the RFA.

4.2.3.2 RF Amplifier (450 MHz)

The RF Amplifier module is a three-stage power amplifier designed to produce 10 watts (nominal) output power over the 440–470 MHz band when driven with a +20 dBm (nominal) input signal. The heart of the module is a high gain UHF power amplifier hybrid device (AR1) that exhibits excellent stability and ruggedness. AR1 provides 20 dB of gain and the power output is factory-set in the transmitter for 10 watts by adjustment of the +12.5 VDC supply on the Audio/Power Supply board. Field adjustment of the power supply is not recommended since other design considerations will be compromised (i.e., DC power consumption, temperature stability, efficiency, etc.).

CAUTION:

Power must be limited to +23 dBm (200 mW) or permanent damage to the module may result.

The PA current sample is derived across R2 plus any additional line losses to provide 0.18 volt/amp sensitivity at the RFA input terminals (C701 and C702). This sample is fed to the Audio/Power Supply board and a test point is provided for monitoring.

The seven-section low-pass filter following AR1 is realized in a lumped element configuration utilizing air-coil inductors (L3, L4, L5) and chip capacitors (C6, C7, C8, C9). The filter attenuates the harmonics of the final stage to better than -60 dBc per FCC requirements.

The dual-directional coupler (DC1) is fabricated using a copper shielded twisted-pair coaxial line to provide high-directivity, therefore assuring accurate forward and reflected power sampling. Detectors CR2 and CR3 provide DC meter samples for reflected and forward power, respectively. These sample voltages are fed to the Audio/Power Supply board. The forward and reflected power sample is conditioned and fed to the meter for monitoring. Forward power voltage level at C721 is approximately 2.5 VDC for the nominal 10 watts output. Reflected power voltage level at C722 is approximately 2.5 VDC for the 100% reflected power.

The RFA supply bridge diode (CR101) and regulator (Q101) are mounted to the heat sink of the RFA.

4.2.3.3 RF Amplifier (330 MHz)

The RFA module is a three-stage discrete bipolar amplifier utilizing lumped elements for impedance matching and tuning. The amplifier provides 20 dB of gain to an output level of 10 watts.

The input applied at J1 is nominally +20 dBm (100 mW). The first stage (Q1) is operated class A and its input matched by C5, C8, and L1. This stage provides 9 dB of gain. The output of the first stage is tuned and matched to the input of the second stage by L2, C8, and C11. The second stage is operated class C and provides 7 dB of gain. The output of the second stage is tuned and matched to the input of the final stage by L4, C13, and C16. The final stage is operated class C and provides 6 dB of gain. L5, L6, C18, and C17 match the final output impedance into the 5-element low pass filter (C19, L7, C20, L8, C21). The filter attenuates harmonics of the final stage to better than -60 dBc per FCC requirements. The output impedance of the filter is 50 ohms.

The dual directional coupler is composed of two coupled-line microstrip sections. The forward and reflected power levels are rectified by diodes CR1 and CR2, respectively. These levels are filtered with RC low-pass networks to reduce EMI in the meter sample output lines. The final current sample (0.18 VDC/Amp) is provided by R5 and is metered (nominal 2.2 amp).

The RFA supply bridge diode (CR101) and regulator (Q101) are mounted to the heat sink of the RFA.

4.2.3.4 RF Amplifier (220 MHz)

The RF Amplifier is a two-stage discrete bipolar amplifier utilizing lumped elements for impedance matching and tuning. The amplifier provides 20 dB of gain to an output level of 10 watts.

The input applied at J1 is nominally +20 dBm (100 mW). The first stage (Q1) is operated class C and its input matched by C1, C2, and L1. This stage provides 12 dB of gain. The output of the first stage is tuned and matched to the input of the final stage by L3, C5, and C6. The final stage is operated class C and provides 8 dB of gain. L6, L7, C11, and C10 match the final output impedance into the 6-element low pass filter (L8, C12, L9, C13, L10, C14). The filter attenuates harmonics of the final stage to better than -60 dBc per FCC requirements. The output impedance of the filter is 50 ohms.

The dual directional coupler is composed of two coupled-line microstrip sections. The forward and reflected power levels are rectified by diodes CR1 and CR2, respectively. These levels are filtered with RC low-pass networks to reduce EMI in the meter sample output lines. The final current sample (0.18 VDC/Amp) is provided by R4 and is metered (nominal 2.2 amp).

The RFA supply bridge diode (CR101) and regulator (Q101) are mounted to the heat sink of the RFA.

4.2.3.5 RF Amplifier (1.7 GHz)

The RFA module is a four-stage discrete amplifier utilizing microstrip matching elements for impedance matching and tuning. The amplifier provides 38 dB of gain to an output level of 6 watts.

The input applied at J1 is nominally 0 dBm (1 mW). The first three stages are common-source class A FET amplifier stages utilizing a bipolar DC bias scheme requiring the -15 VDC supply. The gain of each stage is set by the gate bias adjustment. The final stage is a common-base class C bipolar design that is matched directly into the 7-element low-pass filter. The filter

attenuates harmonics of the final stage to better than -60 dBc per FCC requirements. The output impedance of the filter is 50 ohms.

The dual directional coupler is composed of two coupled-line microstrip sections. The forward and reflected power levels are rectified by diodes D2 and D1, respectively. These levels are filtered with RC low-pass networks to reduce EMI in the meter sample output lines. The final current sample (0.16 VDC/Amp) is provided by R31 and is metered (nominal 2.0 amp).

The RFA supply bridge diode (CR101) and regulator (Q101) are mounted to the heat sink of the RFA.

4.2.4 Channel Control Board (Multichannel Option)

The Channel Control Board is used to control the RF module frequency selection, provide front panel display, and implement the remote control facilities for channel selection. The transmitter version (-1) provides gain compensation for the FMO modulation sensitivity variation with frequency change.

Mux IC (U4) selects either the front panel channel select switch (S1) or the CHANNEL REMOTE INPUT (P1-1, -2, -3, -4), providing a BCD output to the address lines of the EPROMs (U1, U2, and U3) for channels 0–15. The remote input is toggled active by the REM ENABLE line (P1-5) which also controls the RMT LED on the display (DP, upper left corner). Board mounted INTERNAL MODE switch (S6) emulates the remote input function for internal security lockout of the front panel channel selection.

Logic IC (U5) decodes and detects channel address number 0 to toggle between EPROM control (PROM ENABLE) and on-board manual programming control (CHNL 0 ENABLE) via switches S2, S3, S4, and S5. The EPROM outputs (PROM PROGRAM) are buffered by bus drivers U7, U8, and U9. The switch outputs are buffered by bus drivers U10, U11, and U12. The driver outputs are parallel connected (PROGRAM OUTPUT BUS) and enable bank switching of the outputs. When channel number 0 is selected, the switches take control and the RF module may be programmed for a user-specified frequency. The programming bits are assigned as shown in Table 4-1.

Table 4-1
Transmitter Channel 0 Programming

Bit Name	Assignment	Comments
N8	64 MHz	
N7	32 MHz	
N6	16 MHz	
N5	8 MHz	
N4	4 MHz	
N3	2 MHz	
N2	1 MHz	
N1	500 kHz	
N0	250 kHz	
A3	200 kHz	
A2	100 kHz	
A1	50 kHz	
A3	200 kHz	
C5	“FIX” CAP ACTIVE	RF Module Circuit
C4	“F2” CAP ACTIVE	RF Module Circuit
C3	“F1” CAP ACTIVE	RF Module Circuit
C2	“MOD1” ADJ ACTIVE	TX Only
C1	“MOD2” ADJ ACTIVE	TX Only
C0	“MOD3” ADJ ACTIVE	TX Only

The two digit display (DGT1, DGT2) is controlled by the EPROM outputs D0–D4. D0 controls the 10's digit and D1–D4 (BCD DISPLAY) are decoded by U13 to provide the 1's display. For systems with less than 16 channels, the display will blank and no programming is available. DGT1 may be tested by shorting jumper E1 (DGT1 TEST).

Analog switch IC (U6) is used to compensate for modulation gain variations with frequency in the FMO (located in the transmitter RF Module). Each pot adjustment (R12, R13, and R14) operates independent of each other and is factory set for each system configuration.

4.3 Receiver Theory of Operation

4.3.1 Receiver Audio/Power Supply

4.3.1.1 Power Supply (AC)

The power supply consists of an AC power connector (P1), transformer, rectifier (CR1), capacitive filters (C4, C5), and fixed linear regulators (VR1, VR2, VR3, VR4). The power supply has four output voltages: +15, -15, +5, -12. The regulated -12 VDC is used to power the crystal ovens for the 1st LO and 2nd LO crystals.

WARNING:

Failure to ground the third lead of the input power cord may result in hazardous shocks to personnel.

The AC power connector includes an RF filter. The transformer primary windings support the four selectable input voltage ranges (100, 120, 220, and 240 VAC). Operating voltage is selected by programming the line filter/fuse holder on the rear panel as described in Section 2.2.1, AC Line Voltage Selection.

4.3.1.2 Mute and Transfer

The Mute and Transfer circuitry contains the necessary logic to squelch the receiver during periods of insufficient RF signal strength. The receiver will mute whenever one or more of the following conditions are present:

1. The signal mute line (SIGMUTE, P5-4) from the IF Demod module (PCL6020) or FM Demod module (PCL6030/6060) is at a logic low level (0 VDC).
2. The rear panel remote mute input (MUTEIN, P2-8) is grounded.
3. The rear panel auto transfer input (XFERIN, P2-9) is at a logic high level (+5 VDC). This signal will force the collector of Q1 to a logic low level.
4. The front panel momentary manual transfer switch (S1) is activated, also forcing the collector of Q1 to a logic low level.
5. The AFC LOCK signal from the RF module (P3-6) is at a logic low level, indicating a loss of lock condition in the 2nd LO.

When one of the above conditions is present, pin 6 of U15a will go to a logic high level. This signal activates the FET mute switch (U1). This signal is inverted by U15b to control the front panel “OPERATE” status LED and activate the driver/inverter U16.

U16c is a high current relay driver for the mute relay (K1). When the receiver is muted, pin 6 of U16 will go high and no current will flow through the relay coil. This condition is also true if power to the receiver is lost. In the mute mode, K1 disconnects the program signal at P2-20 (composite), P2-18 (MONO+), P2-16 (MONO-), and P2-14 (MUX). The armature contacts of K1 are connected to the rear panel to activate alarms.

U16a and U16b form a non-inverting relay driver for remote transfer to another receiver in a hot standby installation. This output (XFEROUT) appears at P2-7 and is routed to the rear I/O panel. Refer to Section 2 of this manual for further information.

4.3.1.3 Metering and Status

The Metering Functions are selected by the front panel meter switch (S2) and are calibrated by potentiometers R210 (+15V), R212 (-15V), R213 (+5V), R172 (SIG LVL), R171 (PGM LVL), R170 (MUX LVL), R169 (AFC LVL), R169 (LO1), R168 (LO2), R167 (LO3). The signals are processed by absolute value amplifier and peak detector U19. This output is followed by a buffer and meter ballistics amplifier U20. R186 (METER ZERO) is used to electrically zero the meter. R196 (METER BALLISTICS) is used to adjust the meter acceleration and ballistics response.

Amplifier U17b drives the “SIGNAL” LED (CR20) on the front panel. “SIGNAL” is red when a carrier signal is not present, and green when a carrier signal is present.

Amplifier U17a drives the “AFC LOCK” LED (CR19) on the front panel. Green indicates the 2nd LO/Synthesizer is properly locked. Red indicates a loss of lock.

Amplifier U18a drives the “OPERATE” LED (CR21) on the front panel. Green indicates the receiver is not muted as determined from the Mute and Transfer circuitry. Red indicates a mute or standby condition.

4.3.1.4 Audio Processor

The baseband input enters the Audio/Power Supply board at J1. U1 is a FET mute switch that is controlled by the Mute and Transfer circuitry and prevents high level noise from entering the audio processor under a mute condition. Amplifier U2 is configured as a high frequency tilt compensation circuit for the IF filter nonlinearities. R7 (COMP HF TILT) is used for composite operation and R208 (MONO HF TILT) is used for monaural operation. The output of U2 is split into low-frequency audio and high-frequency mux signals.

Jumpers E1 and E6 select the composite high pass MUX filter or the monaural high pass MUX filter and route the audio to the appropriate processing circuitry. The high-pass filtered mux signal is buffered by U3, which has a MUX gain adjustment (R12, MUX LVL). Jumpers E7 and E8 select the composite or monaural MUX low pass filters that improve selectivity performance in the MUX channel. Buffer U4 drives the MUX output and provides a metering point.

The composite signal is processed by U5 where R61 (COMP LF TILT) is used to set the low-frequency gain compensation. The seven pole elliptical composite low pass filter (C70–C76, L9–L11) attenuates MUX signals and high frequency distortion products. Buffer U6b isolates and controls the impedance as seen by the filter. U7 is an all-pass delay equalization circuit to correct for IF response and optimize stereo separation. U6a is a summing amplifier for the delay equalizer and R111 (DELAY EQ) optimizes the circuit for each receiver. The audio is monitored at this point for metering. Jumper E9 bypasses the composite LPF and delay equalizer for digital STL applications. Jumper E5 selects the audio for composite or monaural operation.

The monaural signal is processed by U8 which is an active 75 ms de-emphasis network. Adjustments F1 (R23) and F2 (R22) accurately set the de-emphasis curve for optimum response. Jumper E2 enables (IN) or disables (OUT) de-emphasis. The mono signal is optionally routed through a seven pole active filter (U9, U10, and U11) with a 15 kHz cut-off. Adjustments FA (R30), FB (R78), and FC (R82) are used to tune the roll-off of the filter and align the phase linearity of a dual-mono STL link. MONO LF TILT (R88) compensates for low frequency tilt caused by IF filter non-linearities. LPF GAIN (R89) sets the overall mono low pass filter unity gain. Jumper E3 selects the active filter to be in or out of the mono audio processing path. Amplifier U12b enables monaural program level adjustment with R98 (MONO PGM LVL). The

program level is metered at this point and R90 (MONO PGM MTRG) compensates for level changes between composite and monaural system switching. U13 and U14 comprise an active balanced output driver stage capable of +10 dBm audio power.

4.3.2 Receiver RF Module

4.3.2.1 2nd LO/Synthesizer

The 2nd LO/Synthesizer consists of three main subgroups: the RF group, the digital group, and the loop filter. The RF group includes the voltage controlled oscillator (VCO), buffer, reference oscillator, and low-pass filter. The digital group includes a dual modulus prescaler and an integrated PLL IC that provides multiple functions to be described later.

These three groups provide an RF signal source that has good short-term stability, low noise, and is tunable over a wide frequency range. Selecting the appropriate divide ratio synthesizes the crystal-controlled reference oscillator and ensures long-term stability.

The VCO consists of low-noise field effect transistor Q4 in an RF grounded base configuration. The drain of Q4 is connected to the resonant circuit inductor and capacitors. The capacitance for this circuit is provided by C35, C40, and C41, as well as the three switching networks that control the capacitors C26, C30, and C34. The inductance consists of a stripline inductor on the PC board. Feedback to cause oscillation is from the drain to the source consisting of C40 and C41. The normal frequency range of the oscillator is 70.7 to 90.7 MHz.

The signal is buffered by U4, which drives the seven-section elliptical low-pass filter comprised of C55, L6, C56, C57, L7, C58, C59, L8, C60, and C61. This sharp cut-off filter attenuates the harmonics of the 2nd LO. The output is buffered by the resistive attenuator (R78, R79, R80) to provide a level at the mixer of -6 dBm.

R48 is used to sample the VCO output as feedback for the high speed dual-modulus prescaler (U2). The prescaler divides the 80.7 MHz signal by 10 or 11, depending on the divide ratio selected by the integrated PLL chip (U1). This technique enables one divider IC to be used for small step sizes. The PLL chip contains programmable dividers (/N, /A, /R), a digital phase detector, modulus control logic, and lock detect circuitry to reduce chip count and increase reliability in synthesizer designs.

OSC1 is a temperature compensated crystal oscillator (TCXO) that provides a stable, low phase noise reference oscillator for the phase lock loop. The internal phase detector compares the VCO and reference oscillator inputs and delivers a series of pulses to the integrating loop filter.

Loop filter U3 is an integrating low-pass filter that removes most of the reference frequency component of the phase comparator output. It also provides DC gain to decrease the very low frequency noise of the 2nd LO. Further filtering of the AFC voltage is then delivered to CR10 and CR11 through R30, closing the AFC loop. The frequency stability of the 2nd LO is maintained by CR10 and CR11, which is attached to the stripline inductor through C62. A voltage generated by the AFC circuitry changes the capacitance of CR10 and CR11, which is also part of the tuning of the VCO resonant circuit. Depending upon which capacitors are switched into the resonant circuit—F1 (C34), F2 (C30), or FIX (C26)—the AFC level adjustment is used to place the phase-locked loop in the center of its operating control range. This is indicated by a nominal +7 VDC AFC level.

For Multichannel operation, different capacitors are switched in to maintain an AFC range between 5–9 VDC for different channel frequencies. These switching networks are labeled F1, F2, and FIX. A logic level of +5 VDC at the input of the buffers (Q3, Q2, Q1) will connect that corresponding capacitor into the resonant circuit. If the Multichannel option is being utilized in the

system, these settings come from the Channel Control board's programmed inputs at J11-5, -18, and -6, and switch S4 must be disabled (open circuit). If the RF module is being used as a stand-alone, switch S4 is used to switch in the required capacitors. In either case, green LED indicators CR6 (F1) and CR5 (F2) will light to indicate which setting is active. The FIX capacitor is normally used to band-switch to a frequency far removed from the initial setting.

The lock detect signal at U1-28 is a series of pulses at the step size rate (25 kHz) when the loop is locked. The low pass filter (R19 and C13) provide an average voltage at U3-5 of +5 VDC when the loop is locked. If the loop becomes unlocked, the average voltage drops to 2.5 VDC. This causes the output of comparator U3 to change state which lights the red LOSS OF LOCK LED on the module. Also, the voltage at FL2 drops from +5 to 0 VDC, causing the radiate control circuitry to put the transmitter in STANDBY.

The output frequency of the 2nd LO is determined by the divider values programmed into the PLL chip U1. If the Multichannel option is being utilized in the system, these settings come from the Channel Control board's parallel inputs at J11, and the internal switches S1, S2, S3, and S4 must be disabled (S4 open circuit and S1,2,3 set to “F”). If the RF module is being used as a stand-alone, the frequency is set by the values of switches S1, S2, S3, and S4. The output frequency is determined by adding the resultant frequency values set by each switch. S4-1 is a one-bit switch that sets 64 MHz. S1, S2, and S3 are four-bit switches set to a hex value (0,1,2,3,4,5,6,7,8,9, A,B,C,D,E,F), where A–F corresponds to 10–15. The transmitter frequency example below illustrates the math.

Receiver 2nd LO frequency example:

```
1st LO          =   1020.000  MHz
Carrier Freq    =  - 950.000
1st IF Freq     =     70.000  MHz

                    1st IF Freq     =     70.000  MHz
                    2nd IF Freq     =   + 10.700  MHz
                    2nd LO/Synth    =     80.700  MHz

      SWITCH SETTINGS:     S4-1   1    X     64   =    64.000   MHz
                            S1    4    X      4   =    16.000
                            S2    2    X    .25   =      .500
                            S3    8    X   .025   =     0.200
                                                       80.700   MHz
```

(Note: See section 5.3.9 for changing the STL frequency in the field)

4.3.2.2 1st Local Oscillator (950 MHz)

The receiver 1st LO is identical to the transmitter 1st LO circuit. See section 4.2.2.2 (TX RF Module) for a detailed circuit description.

4.3.2.3 1st Local Oscillator (220 MHz)

The receiver 1st LO is identical to the transmitter 1st LO circuit. See section 4.2.2.3 (TX RF Module) for a detailed circuit description.

4.3.2.4 1st Local Oscillator (330/450 MHz)

The receiver 1st LO is identical to the transmitter 1st LO circuit. See section 4.2.2.4 (TX RF Module) for a detailed circuit description.

4.3.2.5 1st Local Oscillator (1.7 GHz)

The 1st LO signal is derived from crystal-controlled oscillator Q5. The fifth overtone crystal (Y1, 102.000 MHz nominal) is temperature stabilized by a 65°C proportionally controlled oven (HR1). Oscillator buffers Q6 and AR1 isolate the oscillator and amplify the signal, preventing frequency pulling when adjusting the multipliers.

The output of the buffer is doubled in an active push-push doubler. The single-ended input from the buffer is split into two out-of-phase voltages in T1 and applied to the bases of Q7 and Q8. The output of these two transistors is summed at their collectors.

The output of the doubler is tuned by C94 and L14 and is impedance matched to the step-recovery diode multiplier by C95 and C96. The diode self-bias current is determined by RT1. The step-recovery diode (CR14) forms the heart of a X8 multiplier (C98, C99, and a microstrip element). The multiplier converts the input sinusoidal signal to a stream of impulses. These impulses are fed to C101, which is tuned to the desired output frequency. The multiplier output is routed through an external three pole helical filter and is tuned to the LO output frequency (1632 MHz nominal). The output is terminated into a 3 dB attenuator, reducing the output power to that required by the 1st mixer and providing a wideband match for the filter. The undesired harmonics are suppressed at least 40 dB. The output power is between +5 and +9 dBm.

4.3.2.6 Preselector/Preamplifier/1st Mixer (950 MHz, PCL6020/6030)

The receiver RF input passes through a two-pole helical filter (FL12) to protect the succeeding low-noise preamp from high level carriers. The preamp (AR2) is a monolithic gain block with a gain of 14 dB (NF = 2.8 dB). The three-pole helical filter (FL11) provides image frequency rejection and front-end selectivity characteristics (BW = 20 MHz). Mixer HY1 performs the first down-conversion, in conjunction with the 1st LO, to the 1st IF (60–80 MHz).

4.3.2.7 Preselector/Preamplifier/1st Mixer (950 MHz, PCL6060)

In order to accommodate the PCL6060 receiver, the RF module is configured differently. The Preselector, Preamplifier, 1st Mixer and 1st IF amplifier are not installed and the 1st LO is routed to the IF output connector (J2). See the description of the Preamp/1st Mixer module below.

4.3.2.8 Preselector/Preamplifier/1st Mixer (150–450 MHz)

The receiver RF input passes through an external three-pole helical filter to protect the succeeding low-noise preamp from high level carriers and provide the front-end selectivity characteristic (BW = 8 MHz). The preamp (AR2) is a monolithic gain block with a gain of 20 dB (NF = 2.8 dB). Mixer HY1 performs the first down-conversion to the 60–80 MHz IF.

4.3.2.9 Preselector/Preamplifier/1st Mixer (1.7 GHz)

The receiver RF input passes through an external five-pole interdigital coupled resonator filter to protect the succeeding low-noise preamp from high level carriers and provide the front-end selectivity characteristic (BW = 20 MHz). The preamp (AR2) is a monolithic gain block with a gain of 14 dB (NF = 2.8 dB). Mixer HY1 performs the first down-conversion to the 60–80 MHz IF.

4.3.2.10 1st IF Amplifier (PCL6020/6030)

The IF output of the mixer (HY1) is terminated with a constant-impedance diplexer network (C108, L18, R79, C109, L19) and wideband amplifier AR3 that has a high intercept point to prevent interference intermodulation. The 1st IF amp also buffers the mixer output and provides gain to overcome conversion losses.

4.3.3 Preamp/1st Mixer (950 MHz, PCL6060)

The Preamp/1st Mixer module has been designed to provide optimum service in the most hostile RF environments. The active attenuator, low-noise preamplifier, 1st mixer, and 1st IF amplifier are integrated in this module.

The input signal is applied to a PIN diode attenuator normally set to minimum loss (0.5 dB). By adjusting the diode bias via R13 (RF ATTEN ADJ), the attenuator can be set to approximately 15 dB to prevent preamp overload in very high level RF environments.

The signal is split by a 3 dB hybrid coupler (microstrip design). The outputs are each applied to low-noise amplifiers Q3 and Q4. Each amplifier employs active bias (Q2, Q5) to stabilize the best low-noise bias conditions. The outputs are recombined by another hybrid coupler. This configuration increases the third intercept point by 3 dB, providing an extremely robust front-end preamp.

The signal passes through a microstrip image noise filter to be applied to the 1st mixer (U1). At this point, the carrier signal is down-converted to the 1st IF (60–80 MHz) by mixing with the 1st LO (1020 MHz).

The IF output is terminated with a constant-impedance diplexer network (C8, L4, R4, C7) and tuned amplifier Q1 that has a high intercept point to prevent interference intermodulation. The 1st IF amp also buffers the mixer output and provides gain to overcome conversion losses. C4 and L3 tune the output of the amp to provide filtering.

4.3.4 IF Demod (PCL6020)

The IF Demod module incorporates several functions including the 1st IF bandpass filter, 2nd mixer, 2nd IF filters, and FM demodulator.

The input signal at the 1st IF (60–80 MHz) enters at J2 and is amplified by Q3 to overcome the succeeding filter losses. The nominal 70 MHz BPF is a 3-pole lumped element, synchronously-tuned, capacitively coupled design whose primary purpose is to reduce undesired signals to levels that will not cause intermodulation in the 2nd mixer and IF amplifier. The 10 dB bandwidth is 4 MHz. Jumper E1 can be used to access this filter for testing.

The 2nd mixer performs down conversion of the carrier to 10.7 MHz. The output is diplexed (L1–L3, C1–C3, R4) to provide a constant impedance filter function and is amplified by Q1, Q2, and associated circuitry.

The FM demodulator is comprised mainly of U2, a high performance integrated circuit designed for wideband FM demodulation at 10.7 MHz and provides a low noise, low distortion output in addition to providing a variety of internal functions. The input (pin 1) is preceded by the 1st IF Filter (FL7) which is a linear phase, monolithic ceramic resonator. The signal is buffered and the output (pin 2) is applied to the 2nd IF Filter (FL8). These filters set the selectivity of the receiver and are adjusted for minimum distortion by C13 and C18. The signal is then fed to the IF limiter amplifier input (pin 5) and the quadrature detector circuit (pins 10 and 11). The quadrature tank circuit (C26, C68, R16, L8, and L9) is singly tuned and U2 provides a distortion compensation circuit internally to achieve this simpler approach to quadrature detection. The demodulated baseband output (pin 15) is applied to amplifier U4 and the output is adjusted by R19. Baseband level (TP2) may be used for monitoring. The IF limiter also provides a logarithmic meter output (pin 8) which is proportional to signal strength. This output is fed to buffer amp U3 and is available on the Audio/Power Supply board for metering. R18 (MUTE THRESHOLD ADJUST) provides feedback to the mute circuit (pin 13) and sets the signal mute level. The mute output (pin 16) is sent to the mute logic circuit located on the Audio/Power Supply board. The current in R17 is zero

when the quad tank is tuned to center frequency, therefore a demod balance voltage is available (TP1) that should be 0 ± 0.5 volt when tuned properly. The test point is available on the Audio/Power Supply board for metering.

4.3.5 Double Converter/LO3 (PCL6030/6060)

System selectivity of the receiver is provided by the Double Converter/LO3 module. The following discussion will describe the signal flow.

The input signal is amplified by Q1 to overcome the insertion loss of the 70 MHz bandpass filter. This amplifier also acts as an impedance transformer from the 50 ohm input impedance to the 3000 ohm impedance of the filter.

The primary purpose of the 70 MHz bandpass filter is to reduce undesired signals to levels that will not cause intermodulation in the 2nd mixer and 2nd IF amplifiers. The 10 dB bandwidth of this filter is 4 MHz. The output of the filter is impedance-transformed down to 50 ohms to match the mixer. The output of the filter is applied to mixer U1 through test point E1 and the optional attenuator at E6. This attenuator compensates for differing system gains of the PCL6030 and PCL6060 receivers.

The signal input to mixer U1 is mixed with the 2nd LO signal to produce the 2nd IF signal at 10.7 MHz. The 2nd LO signal is provided by the synthesizer in the RF module. The mixer is double balanced, and its IF port (10.7 MHz) is diplexed (L1, C1, C2, R1) and fed through a filter (L2, C3, L3) to amplifier Q1. The output of the 1st 10.7 MHz amplifier (Q1) is buffered by emitter follower Q2. The source impedance required by filter FL1 is set by R9.

The 1st 10.7 MHz IF filters FL1, FL2, and FL3 are linear phase monolithic ceramic filters that are jumper-programmed for particular receiver configurations (MONO, WIDEBAND COMPOSITE, or NARROWBAND COMPOSITE). C13, C14, and C15 allow a null adjustment of the filter distortion. Amplifier U2 compensates for filter losses and buffers the impedance match between the 1st and 2nd IF filters.

In a similar fashion, the 2nd 10.7 MHz IF filters FL4 and FL5 are jumper-programmed for receiver configurations (MONO or COMPOSITE). C21 and C22 allow a null adjustment of the filter distortion. Amplifier U3 compensates for filter losses and buffers the impedance matching. L11 and C28 form a harmonic and noise filter for the 3rd mixer (U4).

The input to the 3rd mixer is mixed with the 13.7 MHz 3rd LO signal to produce the 3rd IF signal at 3 MHz. The 3rd LO is comprised of crystal oscillator Q4 and buffer Q5. The 3rd mixer is also double balanced and diplexed. The output signal is sent to the FM Demodulator module.

4.3.6 FM Demod (PCL6030/6060)

The FM Demod module performs three major functions:

1. Extraction of baseband information from the frequency modulated input signal
2. Generation of DC metering signal proportional to the logarithm of the input RF carrier over a three-decade range
3. Generation of a mute signal to squelch the receiver when the RF input signal is too low for reliable operation

4.3.6.1 FM Demodulator

The 3 MHz RF signal at J3 is fed to a low-noise amplifier, U4, and its associated circuitry, where it receives approximately 30 dB of voltage amplification. This signal passes through a 3 MHz phase-linear bandpass filter (L8–L10 with C83 and C84). The output of this filter drives a high-gain (60 dB) non-saturating symmetrical limiting amplifier U6. The amplitude-limited signal is then fed to a precision charge count FM detector to extract the baseband information.

The FM detector operates as follows: Q15, Q16, and Q18 form a differential amplifier with Q13 and Q14 serving as constant-current collector loads. This amplifier has a gain in excess of 30 dB. Q10 and Q17 in conjunction with diodes CR15 through CR17 form low-noise voltage clamps to ensure non-saturating action of the differential amplifier transistors. The current outputs of the differential amplifier alternately charge C62 and C63 through diodes CR12 and CR13. These capacitors are then alternately discharged through Q11 and Q12, the total current being proportional to the signal frequency. Q11 and Q12 serve as current-to-voltage converters whose outputs are combined and integrated in a 500 kHz low-pass filter (L4 and L5 and associated circuitry). The output from this filter contains the baseband information.

A two-stage low-noise amplifier (U5 and U1) then amplifies the baseband signal to a useful system level. Jumper E1 sets the baseband gain to compensate for the differences in wideband and narrowband transmitter deviation. Baseband Level Adjust R10 is set to deliver a 3.5 Vp-p signal at J2 for an FM signal with 50 kHz (35 kHz in narrowband mode) deviation. This FM detector is inherently wideband, linear, and adjustment free.

4.3.6.2 RF Signal Strength Detector

The RF signal from U4 is also sent to a four-stage successive limiting differential amplifier (Q2–Q9) through a simple bandpass filter (L3 and C42). Each stage of this amplifier drives an amplitude detector (CR7–CR10), which in conjunction with the summing amplifier U3, produces a DC metering signal at J1-9 that is proportional to the logarithm of the RF input level over three decades of amplitude. This voltage is used to indicate RF signal strength over the range of 3–3000 μV on the front-panel meter. LOG GAIN control R67 is used to establish the linearity of the signal sent to the Metering and Status module.

4.3.6.3 Mute Logic

The RF signal strength voltage from the log amplifier is also sent to comparator U2, which compares this level to a preset reference voltage established by MUTE THRESHOLD ADJUST (R22). Decreasing this reference voltage decreases the signal strength required to initiate the mute condition. Whenever the logic circuitry is in the mute condition, MUTE threshold indicator CR6 will glow red. A 2 dB hysteresis is built into the mute logic to eliminate “chattering” near the mute threshold. Also network CR3, CR4, R16, R17, and C10 provide a fast-attack, slow-release (1 ms and 1.5 seconds, respectively) to and from the mute mode to eliminate “thumps”. The mute signal is brought out on J1-10 and J1-11.

4.3.7 Adjacent Channel Filter (PCL6060)

The Adjacent Channel Filter is an elliptical low-pass baseband filter that attenuates any high frequency signals that could be demodulated by the FM Demod due to adjacent channel interference. These signals can cause slew-rate limiting in successive baseband processing circuits. The filter module is jumper-programmable (E1 and E2) for composite or mono operation.

4.3.8 Channel Control Board (Multichannel Option)

The Channel Control Board is used to control the RF module frequency selection, provide front panel display, and implement the remote control facilities for channel selection. The transmitter version (indicated by “-1”) provides gain compensation for the FMO modulation sensitivity variation with frequency change.

Mux IC (U4) selects either the front panel channel select switch (S1) or the CHANNEL REMOTE INPUT (P1-1, -2, -3, -4), providing a BCD output to the address lines of the EPROMs (U1, U2, U3) for channels 0–15. The remote input is toggled active by the REM ENABLE line (P1-5) which also controls the RMT LED on the display (DP, upper left). Board mounted INTERNAL MODE switch (S6) emulates the remote input function for internal security lockout of the front panel channel selection.

Logic IC (U5) decodes and detects channel address number 0 to toggle between EPROM control (PROM ENABLE) and on-board manual programming control (CHNL 0 ENABLE) via switches S2, S3, S4, and S5. The EPROM outputs (PROM PROGRAM) are buffered by bus drivers U7, U8, U9. The switch outputs are buffered by bus drivers U10, U11, U12. The driver outputs are parallel connected (PROGRAM OUTPUT BUS) and enable bank switching of the outputs. When channel number 0 is selected, the switches take control and the RF module may be programmed for a user-specified frequency. The programming bits are assigned as shown in Table 4-2.

Table 4-2
Receiver Channel 0 Programming

Bit Name	Assignment	Comments
N8	64 MHz	
N7	32 MHz	
N6	16 MHz	
N5	8 MHz	
N4	4 MHz	
N3	2 MHz	
N2	1 MHz	
N1	500 kHz	
N0	250 kHz	
A3	200 kHz	
A2	100 kHz	
A1	50 kHz	
A3	200 kHz	
C5	“FIX” CAP ACTIVE	RF Module Circuit
C4	“F2” CAP ACTIVE	RF Module Circuit
C3	“F1” CAP ACTIVE	RF Module Circuit

The two-digit display (DGT1, DGT2) is controlled by the EPROM outputs D0–D4. D0 controls the 10's digit and D1–D4 (BCD DISPLAY) are decoded by U13 to provide the 1's display. For systems with less than 16 channels, the display will blank and no programming is available. DGT1 may be tested by shorting jumper E1 (DGT1 TEST).

Analog switch IC (U6) is used to compensate for modulation gain variations with frequency in the FMO. Each pot adjustment (R12, R13, R14) is independent of each other and is factory set for each system configuration. This circuit is not installed for receiver applications.

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5 Alignment

5.1 Introduction

This section presents alignment procedures for the PCL6000 and a list of recommended test equipment. Also included are descriptions of all module adjustments, general troubleshooting information, and test fixture diagrams. Relevant troubleshooting information is included at the end of each alignment procedure.

5.2 Test Equipment

Table 5-1 lists test equipment recommended for use in the alignment procedures. Equivalent items of test equipment may also be used. Any test equipment that is used for RF measurements must be rated for the frequency of operation and power levels that may be encountered.

Table 5-1
Recommended Test Equipment

Instrument	Suggested Model & Critical Specifications
Frequency Counter	Tektronix DC-508A 1.3 GHz *(For dual links on the same frequency, include Option 01.)* Single Link ± 5 ppm Dual Link ± 0.2 ppm
Directional Coupler	Microlab/FXR CB-49N 30 dB, 1–2 GHz, 50 ohms
Attenuator, Fixed	Philco 662A-30 or Sierra 661A-30 30 dB, 1 GHz, 50 ohms, 20 watts
Attenuator, Adjustable	Kay Elemetrics Model 432D 1,2,3,5,10,20 dB steps 50 ohm, 1 GHz
RF Signal Generator	Hewlett-Packard Model 8640B with Options 01 & 02 **Frequency Range:** 0.5–1024 MHz **Residual FM:** 30 Hz, 20 Hz–5 kHz >10 Hz, 300 Hz–3 kHz **RF Level Accuracy:** +3.5 dB, -7 to -47 dBm +4.0 dB, -74 to -137 dBm **Output Impedance:** 50 ohm **FM Deviation BW:** DC–250 kHz
Mixer	Mini-Circuit 2AD-1
Audio Oscillator	Hewlett-Packard 204C **Frequency Range:** 100 Hz–200 kHz **Output Impedance:** 600 ohm

Instrument	Suggested Model & Critical Specifications
Distortion Analyzer	Hewlett-Packard 339A or Tektronix AA501 w/ SG5050 and TM503 Main Frame **Residual Noise:** -92 dB (80 kHz) **Input Impedance:** 100 ohm shunted by less than 100 pF **Accuracy:** 20 Hz–20 kHz ±2% 10 Hz–110 kHz ±4% **Oscillator Frequency Range:** 10 Hz–110 kHz **Output Level:** 3 V_{RMS} into 600 ohm **Distortion:** 10 Hz–20 kHz: -95 dB (0.00187%) THD
RF Spectrum Analyzer	Hewlett-Packard Model 8559A with 18IT Display **Frequency Band:** 0.01–3 GHz **Dynamic Range:** 0.01–<70 dB **Display Range:** Log 10 dB and 1 dB/div **Display Accuracy:** Log > 2 dB (full range) **Input Impedance:** 50 ohm **SWR:** 1.3:1 10 dB input attenuation
Audio Spectrum Analyzer	Tektronix 7L5 with Option 25; L3 Plug-in; 7603 Main Frame **Input Impedance:** 1M ohm/29 pF **Input Frequency:** 10 Hz– >500 kHz **Display Range:** 80 dB, log 10 dB/div
Power Meter and Sensor	Hewlett-Packard 435A with 8481A Power Head **Accuracy:** ± 1% of full scale **Power Range:** -25 dBm (3 μW) to +20 dBm (100 mW) full scale
Stereo Generator	Moseley SCG-9A or equivalent **Stereo SNR:** 75 dB **Separation:** 55 dB **THD:** 0.1% or less
Stereo Demodulator	Belar Stereo Modulation Monitor or equivalent **Stereo SNR:** 75 dB **Separation:** 55 dB **THD:** 0.5% or less
Stereo Source Selector	Moseley custom test equipment
Oscilloscope	Tektronix 465 or equivalent **Bandwidth:** 100 MHz
High Freq Scope Probe	Tektronix 100 MHz or equivalent
Multimeter	Fluke Model 77 or equivalent
50 Hz Filter	See Figure 5-15
600 ohm Resistor	RN55D6000F 600 ohm 1% 1/4W

5.3 Alignment Procedures

The PCL6000 alignment procedures include the following:

5.3.1 STL Frequency Alignment

Description

The STL frequency is aligned by using a counter to measure the transmitter output frequency and the receiver 1st LO frequency. A high-precision counter (±0.2 ppm) is recommended to align STL links that are used in a redundant installation. If such a counter is not available, we recommend that both STL systems be aligned at the same time using the same counter.

Procedure

1. Connect the equipment as shown in Figure 5-1.
2. Position the transmitter OPERATE/STANDBY switch to the OPERATE position. Verify that the RADIATE, and AFC LOCK status LEDs are green.

   Using the METER FUNCTION switch, select the FWD PWR position. Verify that the front panel meter reads between -3 and +2 dB on the top scale.
3. Check the serial number label on the back of the transmitter for its operating center frequency. The counter should indicate the frequency within 8 kHz of the specified center frequency. If it does not, proceed to the troubleshooting portion of this procedure and verify that the 1st LO and FMO are operating at their specified frequencies (refer to system data sheet supplied with the unit).
4. While monitoring the counter, adjust the transmitter FMO frequency trim adjustment for a reading of the specified transmitter frequency ±200 Hz.*
5. The receiver 1st LO frequency for the 950 MHz band is 1020.000 MHz ± 8KHz (refer to system data sheet to determine exact frequency of your unit).
6. Calculate the receiver 2nd LO frequency by adding 10.700 to the 1st LO frequency and subtracting the operating frequency (i.e., for a transmitter at 950.000 MHz, the 2nd LO is (1020.000 + 10.700) - 950.000 = 80.700 MHz).

7. Using the counter, adjust the receiver 2nd LO frequency adjustment for a reading within ± 200 Hz of the frequency calculated in Step 6.*

   (Note: If two STL systems are installed for redundant operation, both should be aligned for frequency at the same time.)

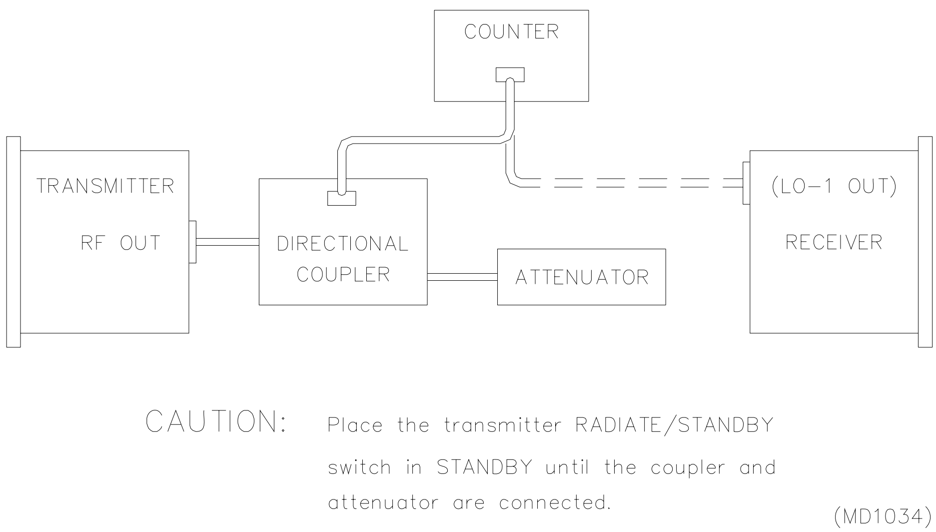


Figure 5-1 Test Setup for Frequency Alignment

Troubleshooting

1. The crystal in the transmitter 1st LO should be to 102.000 MHz for the 950 MHz band (refer to system data sheet to determine exact frequency of your unit).
2. The crystal frequency of the receiver 1st LO should be the same as the PCL6010 transmitter 1st LO (except in the 1.7 GHz band, check the system specs)
3. If the 1st LO fails to meet the ± 8 kHz specified in this procedure, the crystal oven should be checked to ensure that it is operating at 65°C ± 5°C.*
4. If the transmitter frequency fails to meet the ± 8 kHz specified in this procedure and the 1st LO appears to be operating to specification, the FMO should be checked to ensure that it is operating at its designed frequency. The FMO frequency may be calculated as follows:

   For a High-Side LO (LO > CARRIER):
   FMO frequency = (LO freq.) - (CARRIER freq)

   For a Low-Side LO (LO < CARRIER):
   FMO frequency = (CARRIER freq) - (LO freq.)

   *The FMO frequency should be within ± 1 kHz of the value calculated.**
5. A red AFC LOCK status will cause the RADIATE status indicator to remain red.

* **Multichannel Option:** The FMO and 2nd LO are aligned for exact frequency operation (within ±200 Hz of the indicated synthesizer switch settings). To align the STL to the exact carrier frequency of the channel, adjust the 1st LO XTAL tuning capacitor C84.

5.3.2 Receiver Sensitivity

Description

The sensitivity of the PCL6000 receiver is verified using a signal generator and either a de-emphasis network or a de-emphasized stereo demodulator.

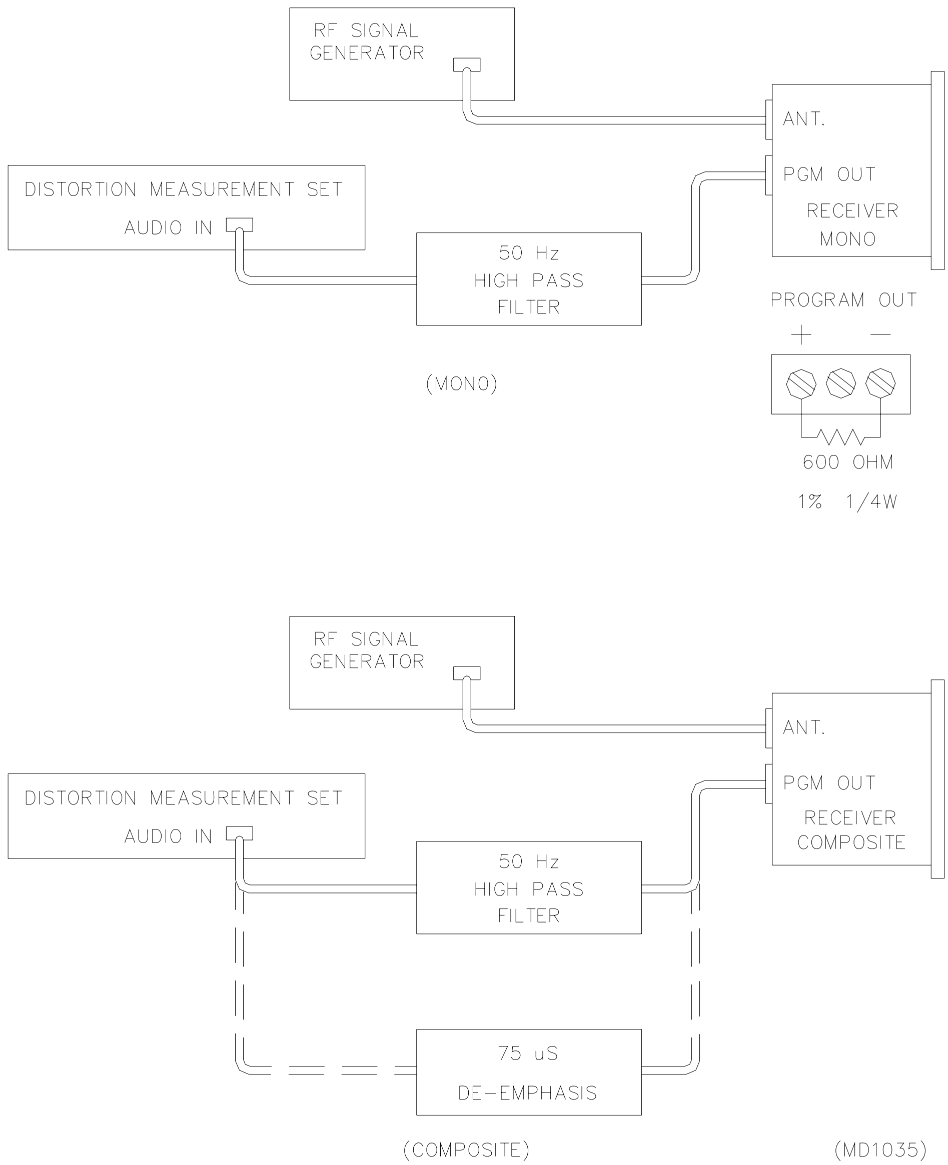


Figure 5-2
Sensitivity Test Setup

Procedure

1. Connect equipment as shown in Figure 5-2. Set the controls on the signal generator as follows:

Meter Level	Volts
AM Modulation	Off
FM Deviation	Off
Frequency	Tuned to center freq (indicated on rear of receiver)
Output Level	-40 dBm (adjust output level for a reading of 3 mV on the signal generator meter)
RF	On

2. Using the METER FUNCTION switch on the PCL6000 Receiver, select the RF LEVEL meter position. Verify that the meter reads within the 3 K range of the middle scale.
3. While monitoring the center scale of the receiver meter, switch the OUTPUT LVL ADJ on the signal generator from -40 to -110 and verify that the signal strength reads within the meter range for each setting. If it does not, proceed to Section 5.4.10, FM Demod (PCL6030/6060), Log Gain Adjust, prior to continuing the test, and perform the calibration adjustments given there. (The PCL6020 system log gain is not adjustable.)
4. Using the METER FUNCTION switch on the receiver, select the PGM LVL position.

   Set FM Deviation on the RF Signal generator to ON.

   Set the modulation frequency on the signal generator to 400 Hz.

   Adjust the deviation control on the signal generator so that the meter on the receiver reads 0 dB on the top scale. Verify that the deviation on the signal generator reads 50 ± 1 kHz.
5. Set the controls on the distortion measurement equipment for a 0 dB reference.

   Set the FM Deviation on the RF signal generator to OFF.

   Position the controls on the distortion measurement equipment for a reading of 60 dB SNR.

   Reduce the RF LVL adjustment on the RF signal generator until the distortion measurement equipment reads 60 dB.

   Observe the RF level output of the signal generator; it should indicate less than 20 μV.
6. Set the controls on the distortion measurement equipment for a signal-to-noise ratio of 40 dB.

   Reduce the RF level on the signal generator until the mute threshold LED on the IF Demod (PCL6020) or FM Demod (PCL6030/6060) module indicates red. Observe the RF level output of the signal generator; it should indicate between 18 and 22 μV. If not, the MUTE THRESHOLD ADJ on the IF Demod (PCL6020) or FM Demod (PCL6030/6060) module should be rotated fully counterclockwise. Then set the RF level output of the

signal generator to 20 μV and adjust the MUTE THRESHOLD ADJ until the mute threshold LED changes from off to red.

Troubleshooting Notes:

The cable between the RF signal generator and the receiver should be kept at a minimum to reduce insertion loss. As an example, a 3-foot cable (RG-58) will cause a 1 dB or 10% loss in signal at 950 MHz.

5.3.3 Receiver Selectivity

Description

The receiver selectivity is verified using an RF signal generator.

Procedure

1. Connect the equipment as shown in Figure 5-3. Set the controls on the signal generator as follows:

Meter Level	Volts
AM Modulation	Off
FM Deviation	Off
Frequency	Tuned to the center frequency (indicated on the serial number label on the rear panel).

Multichannel Option: *Tune to the channel frequency indicated on the “Channel Assignments” label on the rear panel.*

Output Level	-40 dBm (adjust the output level for a reading of 3 mV on the signal generator meter)
RF	On

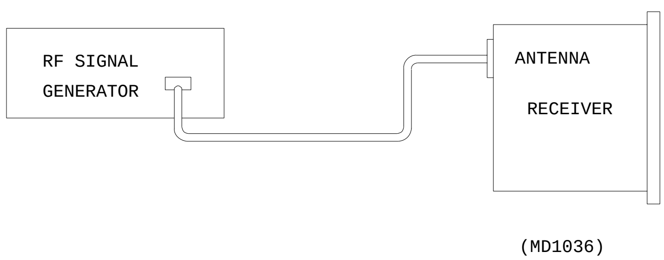


Figure 5-3
Selectivity Test Setup

2. Using the receiver METER FUNCTION switch, select the RF LVL meter position. Verify that the meter reads within the 3 K range of the middle scale.
3. Position the OUTPUT LEVEL switch on the signal generator to -100. Verify that the receiver meter reads within the 3 μV range on the center scale. Note the position of the meter reading as a reference for the -60 dB point.
4. Position OUTPUT LEVEL on the signal generator to -40. Increase the frequency on the signal generator until the meter reading on the receiver front panel is the same as the value noted in paragraph 3. Subtract the carrier frequency from the value indicated on the signal generator. The value calculated indicates the positive -60 dB point.

5. Decrease the frequency on the signal generator until the meter reads the same as the value noted in paragraph 3. Subtract the frequency indicated on the signal generator from the center frequency. This value indicates the negative -60 dB bandwidth point.
6. The bandwidth calculated in steps 3 and 4 should be no greater than ± 400 kHz.

Specification (PCL6020)

Bandwidth	1st 10.7 MHz IF	2nd 10.7 MHz IF
± 90 KHz	1.5 dB	3 dB
±400 KHz	30 dB	60 dB
± 1 MHz	70 dB	80 dB

Specification (PCL6030/6060)

Bandwidth	Wideband	Narrowband
3 dB	±100 kHz	+75 kHz
60 dB	±450 kHz	±350 kHz
80 dB	±1 MHz	±1 MHz

Note: The Wideband/Narrowband filter bandwidth can be selected in the PCL6030/6060 system by properly positioning jumpers E2 and E3 in the Double Converter/LO3 module

Troubleshooting Notes

The cable between the RF signal generator and the receiver should be kept at a minimum to reduce insertion loss. As an example, a 3-foot cable (RG-58) will cause a 1 dB or 10% loss in signal at 950 MHz.

5.3.4 Transmitter Deviation and Receiver Output Level Calibration

Description

The deviation and modulation sensitivity of the composite information is aligned using a Bessel null function as a reference. The MUX channel is aligned using an RF generator as a reference.

Procedure

1. Connect the equipment as shown in Figure 5-4.
2. Adjust the audio oscillator of the distortion analyzer as follows:
    a. Position the meter function switch to the oscillator level position and adjust the oscillator level controls for an output voltage of 1.25 V_{RMS} (composite), 1.00 V_{RMS} (mono).

b. Using the counter to monitor the oscillator frequency, position the frequency controls for 20.79 kHz (composite), 16.62 kHz (mono).

3. Position the transmitter OPERATE/STANDBY switch to the OPERATE position.

   Using the METER FUNCTION switch, select the FWD PWR position and verify that the meter reads between -3 dB and +2 dB on the top scale.

4. Using the spectrum analyzer, monitor the modulated RF output of the transmitter. The controls of the spectrum analyzer should be in the following positions:

Frequency Band GHz	.01–3
Time/DIV	Auto
Trigger	Free run
FREQ/SPAN/DIV	50 kHz/DIV with 3 kHz bandwidth
Input ATTEN	30
REF Level	-20
10 dB/DIV	Depress
Tuning	Transmitter center frequency

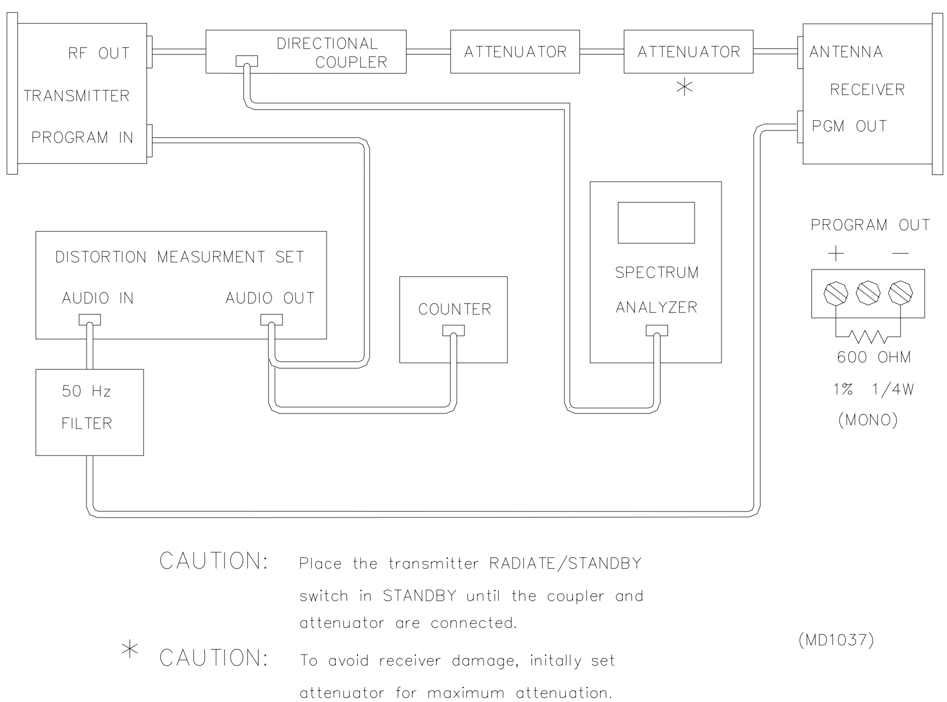


Figure 5-4
Test Setup For Deviation Alignment

5. Disconnect the program input to the transmitter and adjust display on the spectrum analyzer so that the waveform is at the top graticule (see Figure 5-5).

Reconnect the program input of the transmitter. The display on the spectrum analyzer should be similar to Figure 5-5.

Adjust COMP PGM LVL (R28) or MONO PGM LVL (R199) on the Audio/Power Supply board for a Bessel null of at least -50 dB on the spectrum analyzer.

Using the METER FUNCTION switch on the transmitter, select the PGM LVL position. Adjust COMP PGM MTRG (R201) or MONO PGM MTRG (R202) as is necessary on the Audio/Power Supply board for a reading of 0 dB on the top scale of the meter.

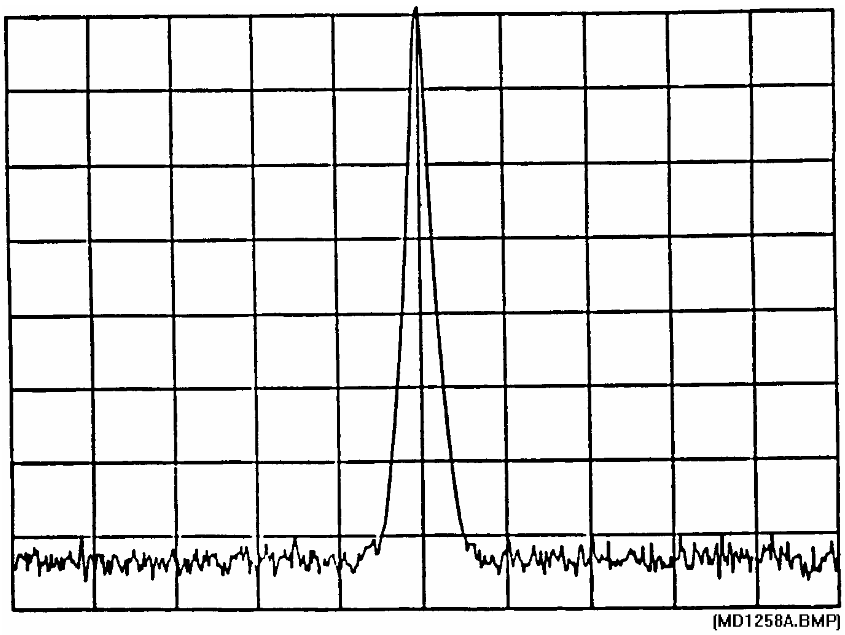


Figure 5-5a Bessel Null Function Waveform

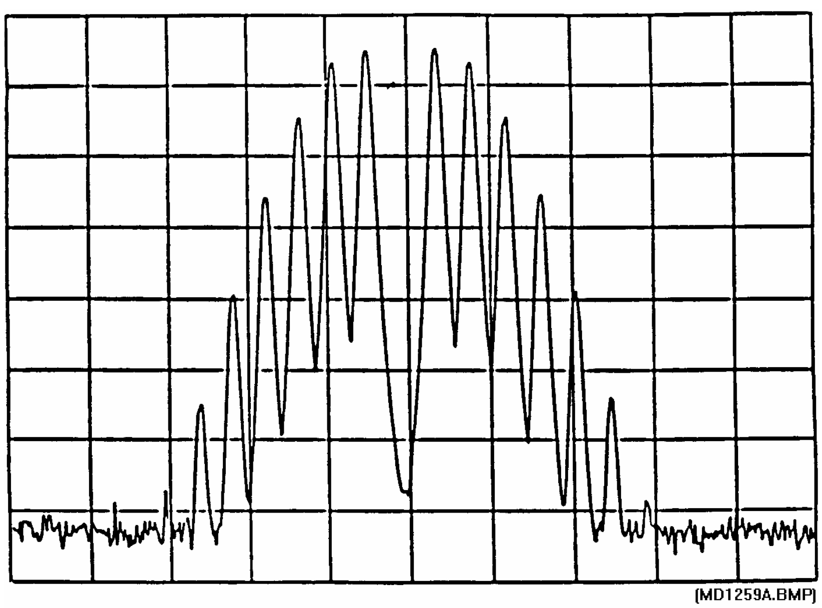


Figure 5-5b Function Waveform Bessel Null

6. Using the METER FUNCTION switch on the receiver, select the RF LVL position.

   Position the switches on the adjustable attenuator for an RF level reading between 1 K and 3 K on the receiver meter.

   Set the controls on the distortion analyzer as follows:

Meter Function	Reference level
Frequency	1.0 kHz
Meter Input Range	+10 dB

   With the oscillator output connected to the transmitter, connect the meter input in parallel with the oscillator output and adjust the Relative Adjust control for a 0 dB reference on the distortion analyzer.

   Reconnect the distortion analyzer input to the program output of the receiver.

   PCL6020: On the receiver IF Demod module, adjust BASEBAND LVL ADJUST (R19) for a reading of 0 dB on the distortion measurement test set.

   PCL6030/6060: On the receiver FM Demod module, adjust BASEBAND LVL ADJUST (R10) for a reading of 0 dB on the distortion measurement test set.

   Using the receiver METER FUNCTION switch, select the PGM LVL position and adjust PGM LVL (R171) on the RX Audio/Power Supply board for a reading of 0 dB on the top scale.

7. Position the transmitter OPERATE/STANDBY switch to the STANDBY position.

   Connect the equipment as shown in Figure 5-6 and adjust the controls on the RF signal generator as follows:

Meter Function	FM
AM	OFF
Modulation Freq.	110 kHz
FM	10 kHz
Output Level	-40
Frequency Tune	Tune to the center frequency (specified on serial number label of receiver).
Peak Deviation	Adjust FM control for a meter reading of 5 kHz.

   While monitoring the oscilloscope, adjust MUX Level. Adjust R31 on the receiver Audio and Power Supply board for a reading of 1.5 V_{p-p}.

   Using the receiver METER FUNCTION switch, select the MUX LVL position.

   Adjust R12 on the RX Audio/Power Supply board for a reading of 5 on the lower scale of the receiver meter.

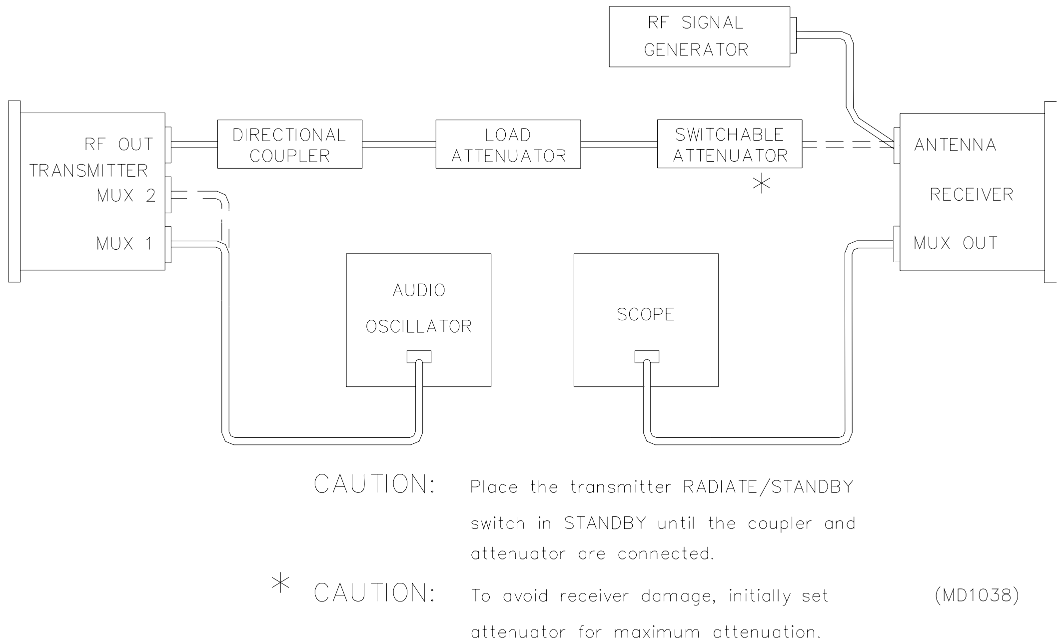


Figure 5-6
Test Setup for MUX Channel Alignment

8. On the RF signal generator, adjust the modulation frequency to 67 kHz and the FM deviation for 6.0 kHz.

   Note the reading on the receiver meter. It should be between 6 and 8 on the lower scale. This reading will be used as a reference to align the transmitter MUX 2 deviation. Connect the output of the adjustable attenuator to the RF input of the receiver.

9. Position the transmitter OPERATE/STANDBY switch to the OPERATE position.

   Using the scope, adjust the output of the audio oscillator for a voltage of 1.5 V_{p-p} and a frequency of 110 kHz (26 kHz mono). Connect the audio oscillator output to the MUX 1 input of the transmitter.

   Adjust the MUX 1 Level Adjust R29 on the Audio/Power Supply board for a reading of 5 on the lower scale of the receiver meter.

   Using the transmitter METER FUNCTION switch, select the MUX LVL position.

   Adjust R159 on the TX Audio/Power Supply board for a reading of 5 on the meter lower scale.

   Connect the audio oscillator to the transmitter MUX 2 input and adjust the oscillator to a frequency of 185 kHz (composite only).

   Using the receiver meter as a reference, on the Audio/Power Supply board, adjust MUX 2 Level Adjust R40 for the reading noted in paragraph 8. The meter reading on the transmitter front panel should be between 6 and 8 on the lower scale.

Troubleshooting

1. When aligning systems as a dual or redundant installation, one transmitter should be used as a reference. In this case, the second transmitter would be aligned using the first receiver as a reference. The second receiver would be aligned using the first transmitter as a reference. As a final verification, the second transmitter would be checked using the second receiver. Using any combination of transmitter and receiver, the composite band should be flat within ±0.1 dB. The results from the MUX band measurements should be within 10%.
2. The MUX output is lowest when the carrier center frequency of the transmitter and receiver are identical.

5.3.5 Ultimate Signal-to-Noise Ratio

Description

The STL ultimate wideband (50 Hz to 15 kHz) SNR, is verified using a distortion analyzer. The receiver SNR (quieting) is verified during the receiver sensitivity test (see Section 5.3.2).

Procedure

1. Connect the equipment as shown in Figure 5-7 and set the controls on the distortion measurement test set as follows:

Meter Function	REF Level
Meter Input	+10 dBm
Frequency	400 Hz

2. Set the controls on the transmitter as follows:

OPERATE/STANDBY	OPERATE (Radiate LED green)
METER FUNCTION	PGM LVL

3. Using the METER FUNCTION switch on the receiver, select the PGM LVL position.
4. Adjust the oscillator output level on the distortion measurement test set for a reading of 0 dB on the top scale of the transmitter meter.

   Rotate the REFERENCE ADJUST on the distortion measurement test set for a 10 dB reference on its front-panel meter. Disconnect the composite input at the transmitter rear panel.

   Using the INPUT RANGE switch on the distortion measurement test set, measure the ultimate wideband SNR. (Note: The reference is +10 dB; hence, a meter input range indicating -60 and a meter reading of -6 would indicate an SNR of -76 dB.)
5. Position the INPUT RANGE switch to +10 dB and reconnect the program input to the transmitter composite BNC connector.

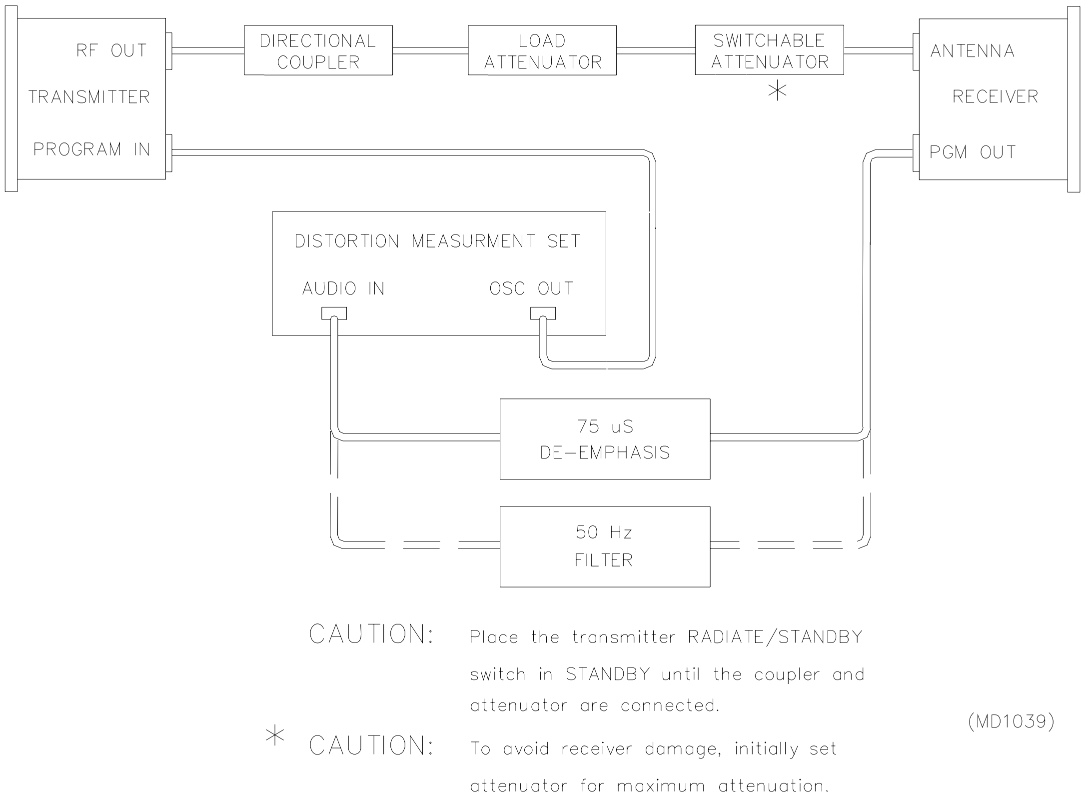


Figure 5-7
Test Setup For Signal-To-Noise Ratio Measurement

Troubleshooting

1. If the STL link fails to meet the ultimate SNR specification, the sensitivity test (paragraph 5.3.2) should be performed on the receiver prior to troubleshooting the transmitter.
2. If the STL link fails to meet the SNR specification, and the transmitter is suspected, the following method may be used to help isolate the problem:
    a. Using the 80 kHz filter on the distortion measurement test set, measure the baseband output of the TX Audio/Power Supply board for a reading at least 5 dB greater than specified for the ultimate SNR.
    b. Substitute the 1st LO signal (1020 MHz for the 950 MHz band) using an RF signal generator such as the HP 8640B at an output level of +10 dBm.
    c. Substitute the FMO signal using the RF signal generator at an RF level of 0 dBm.

5.3.6 Distortion Alignment

Description

A distortion analyzer is used to align the receiver 10.7 MHz IF filters for minimum distortion. This method assumes the FMO will contribute a negligible amount of distortion to the overall reading.

The FMO distortion can be verified independently of the receiver by referring to Section 5.3.10 (FMO Adjustment).

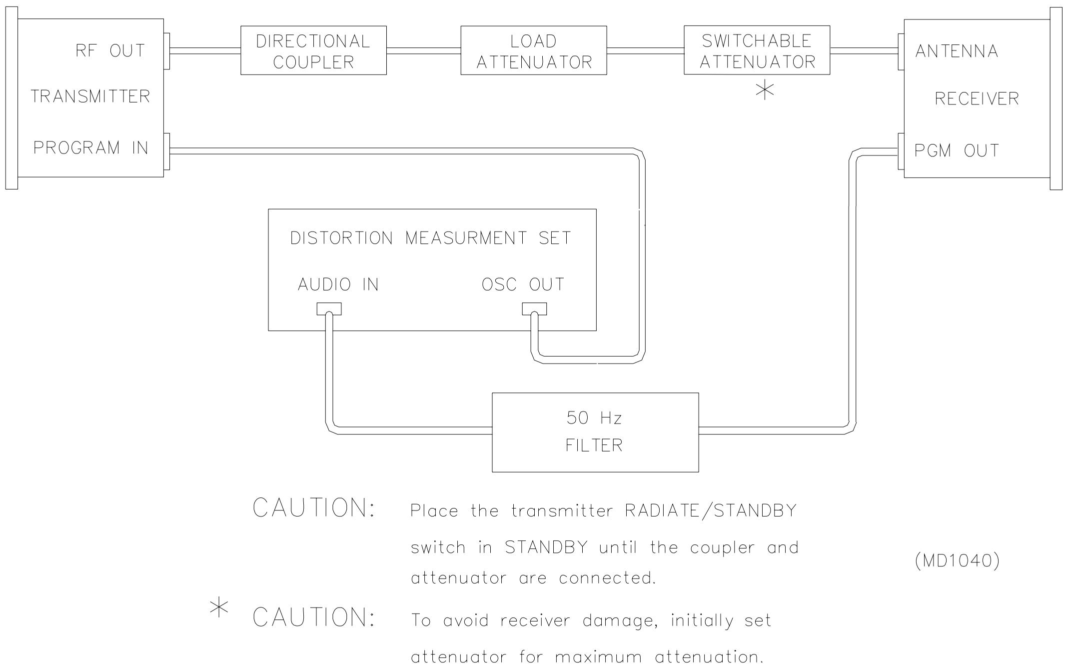


Figure 5-8
Test Setup for Distortion Alignment

Procedure

1. Connect the equipment as shown in Figure 5-8 and adjust controls on the distortion measurement test set as follows:

Meter Function	Input level
Filters	400 Hz - In; 80 kHz - In
Distortion Range	0.3%
Input Range	+10 dB
Frequency	1.0 kHz
Oscillator Level	+10 dBm from 600 ohm source

2. Position the OPERATE/STANDBY switch on the transmitter to the OPERATE position. The RADIATE status LED should be green. Using the METER FUNCTION switch on the transmitter, select the FWD PWR position and verify that the meter reads between -3 and +2 dB on the top scale.

   Using the METER FUNCTION switch on the transmitter, select the PGM LVL function and verify that the meter reads between -1 and +1 dB on the top scale.

3. Using the METER FUNCTION switch on the receiver, select the RF LVL function.

Position the switches on the adjustable attenuator for a reading between 1 k and 3 k microvolts on the middle scale of the receiver meter.

Using the METER FUNCTION switch on the receiver, select the PGM LVL function. The meter should read between -1 and +1 dB on the top scale.

Set the frequency to 15 kHz and verify that the meter of the distortion measurement test set reads between .9 and 1.1 VRMS.

Adjust the METER FUNCTION switch on the distortion measurement test set to the DISTORTION position.

4. Using the distortion measurement test set, adjust the following controls on the IF Demod (PCL6020) or Double Converter/LO3 (PCL6030, PCL6060) for minimum distortion:

PCL6020: a. 1ST 10.7 MHz IF ADJ

b. 2ND 10.7 MHz IF ADJ

PCL6030/6060: a. 1ST 10.7 MHz IF ADJ (MONO, WB COMP, NB COMP)

b. 2ND 10.7 MHz IF ADJ (MONO, COMP)

Check the receiver configuration to verify which filter adjustments; MONO (monaural), WB COMP (wideband composite), or NB COMP (narrowband composite) pertain to your system.

5. The distortion reading should now be less than 0.2%. Switch the frequency on the distortion measurement test set to 1.0 kHz. Verify that the distortion reading meets specifications.

Troubleshooting

1. The following procedure may be used to determine if the 10.7 MHz filters are a source of high distortion.

   a. PCL6020: Remove FL1 and FL2 from the IF Demod module and replace it with a 1.0 K ohm resistor. The resistor leads should first be cut between 0.3 and 0.4 inch from the body. The ends of the resistor leads should then be flattened using a pair of needle-nose pliers so they can be inserted in the filter sockets. The cover should then be replaced.

      PCL6030/6060: Remove the appropriate ceramic filters FL1 and FL4 (Monaural), FL2 and FL5 (Wideband Composite), or FL3 and FL5 (Narrowband Composite) from the Double Converter/LO3 module and replace it with a 1.0 K ohm resistor. The resistor leads should first be cut between 0.3 and 0.4 inch from the body. The ends of the resistor leads should then be flattened using a pair of needle-nose pliers so they can be inserted in the filter sockets. The cover should then be replaced.

   b. Using the distortion measurement test set, the distortion reading should now be less than 0.27% at 15 kHz. If it is not, additional troubleshooting will be required prior to determining the performance of the 10.7 MHz IF filters.

2. An RF input to the receiver exceeding 6 mV may cause an indication of high distortion.

3. The distortion of the Audio/Power Supply board in the receiver can be tested independently by applying the output of the distortion analyzer's audio oscillator to the baseband input of the Audio/Power Supply board.

5.3.7 Stereo Separation and Stereo Signal-to-Noise Ratio

Description

The stereo separation alignment is accomplished using a stereo generator and demodulator of known quality and an audio spectrum analyzer with tracking generator.

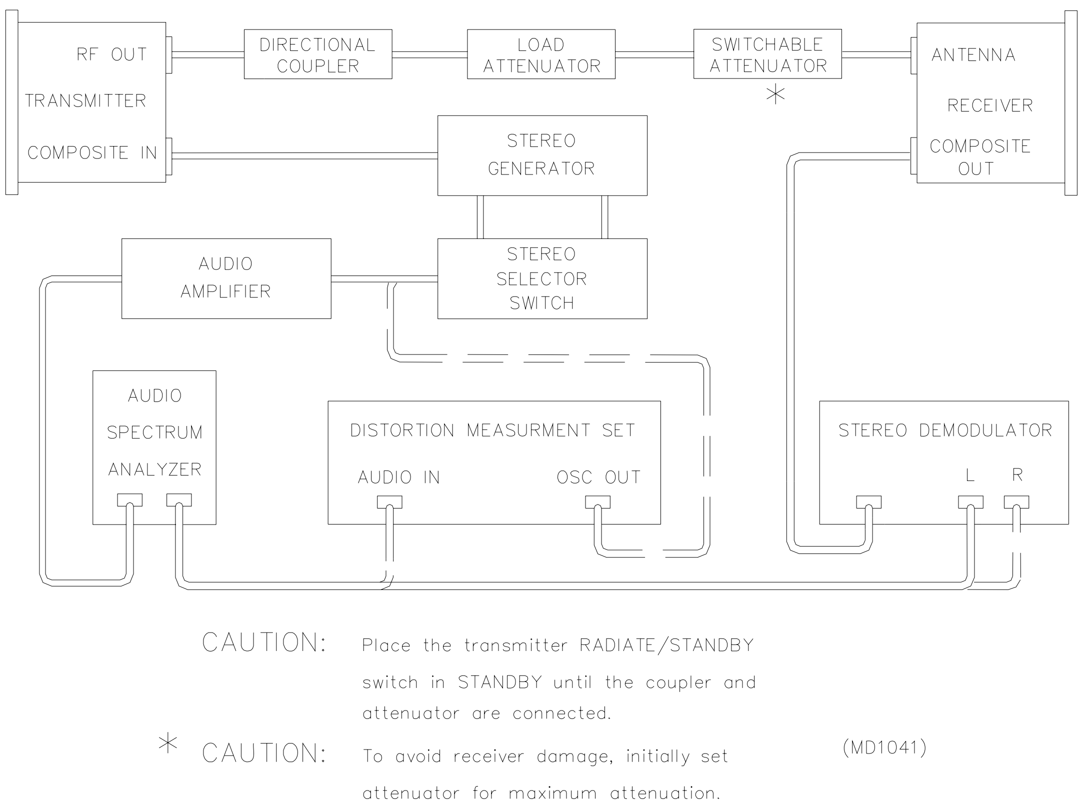


Figure 5-9
Stereo Separation Test Setup

Procedure

1. Connect the equipment as shown in Figure 5-9. This test should be run flat; i.e., the stereo generator pre-emphasis and the stereo demodulator de-emphasis should be switched out. If this cannot be accomplished, the system modulation reference level should be reduced to -20 dB at 400 Hz. Adjust the controls on the audio spectrum analyzer as follows:

Frequency	Far left graticule
Dot Frequency	Zero Hz
LOG	10 dB/DIV
Source	FREE RUN

Mode	NORM
Termination	1 Megohm
REF	dBV
Resolution	Coupled
SPAN/DIV	2 kHz
Time/DIV	Auto
Tracking GEN	ON

2. Set the OPERATE/STANDBY switch on the transmitter to the OPERATE position. Verify that the RADIATE LED is green.

   Using the METER FUNCTION switch on the transmitter, select the FWD PWR position. Verify that the meter reads between -3 and +2 dB on the top scale.

   Using the METER FUNCTION switch on the transmitter, select the PGM LVL position.

   Adjust the dot frequency on the audio spectrum analyzer to 1.0 kHz and the SPAN/DIV to zero.

   Adjust the level control on the audio spectrum analyzer for a reading of zero dB on the top scale of the transmitter meter.

   Set the dot frequency on the audio spectrum analyzer to zero and the SPAN/DIV to 2 kHz.

   Using the METER FUNCTION switch on the receiver, select the RF LVL position.

   Position the switches on the adjustable attenuator for a reading between 1 K and 3 K on the receiver meter middle scale.

   Using the METER FUNCTION switch on the receiver, select the PGM LVL position. Verify that the meter reads within ±1 dB of the transmitter meter.

3. Select the LEFT ONLY position on the stereo source selector.

   Adjust the step and variable attenuators on the audio spectrum analyzer so that the waveform is at the top graticule. (See Figure 5-10.)

   Select the RIGHT ONLY position on the stereo source selector.

   Adjust COMP HF TILT (R7) on the RX Audio/Power Supply board for maximum separation between 1 and 5 kHz.

   Adjust DELAY EQ (R111) on the RX Audio/Power Supply board for maximum separation between 10 and 15 kHz. (See Figure 5-10.)

   Using the SAVE A function on the audio analyzer, store this waveform.

   Verify that the separation meets specification between 1 kHz and 15 kHz.

Stereo separation: Measurement of the worst case ratio in dB of residual signal in the stereo demodulated right channel referred to the demodulated left channel with a left-only driving signal for frequencies between 30 Hz and 15 kHz; the procedure is repeated for right to left channel separation.

4. Connect the spectrum analyzer to the right output of the stereo demodulator.

Select the RIGHT ONLY position on the stereo source selector. Adjust the step and variable attenuators on the audio spectrum analyzer so that the waveform is at the top graticule. (See Figure 5-10.)

Select the LEFT ONLY position on the stereo source selector. Verify that the separation meets specification between 1 kHz and 15 kHz.

Vert = 10 dB/div **Horz = 2 KHz/div**

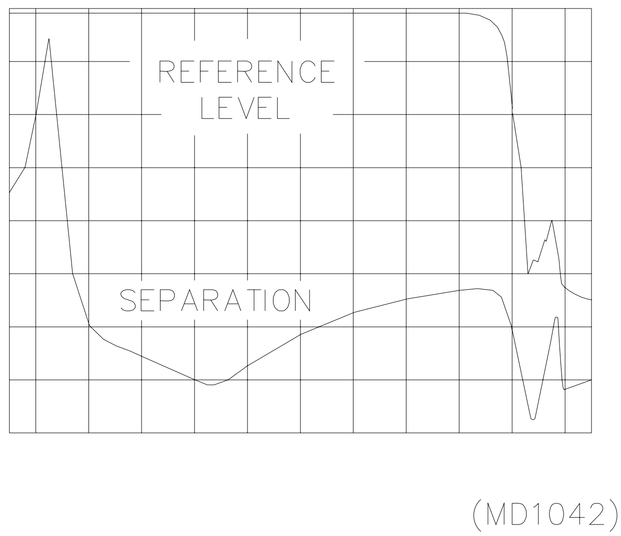


Figure 5-10
Swept Separation Waveform

Note: The COMP HF TILT and DELAY EQ module affect both the left and right channel separation. Paragraphs 3 and 4 may be repeated to assure optimum performance on both channels.

---

5. Connect the audio output of the distortion analyzer to the stereo source selector. Connect the left output of the stereo demodulator to the input of the distortion analyzer.

   Set the frequency on the distortion measurement test set to 1 kHz. Select the LEFT + RIGHT position on the stereo source selector.

   Adjust the output level on the distortion measurement test set for a reading of zero dB on the top scale of the transmitter. Using the METER FUNCTION switch on the receiver, select the PGM LVL position and verify that the meter reads within ± 1 dB of the transmitter program level.

   Adjust the input controls on the distortion measurement test set for a zero dB reference.

   Set the frequency on the distortion measurement test set to 30 Hz.

   Verify that the reference on the distortion measurement test set is ± 0.5 dB.

Select the RIGHT ONLY position on the stereo source selector. Using the input attenuator on the distortion measurement test set, measure the separation.

Adjust COMP LF TILT (R61) on the RX Audio/Power Supply board for maximum separation.

Verify the separation at 50, 100 and 500 Hz.

6. Connect the input of the distortion analyzer to the right channel of the stereo demodulator.

Position the input range and relative ADJ controls on the distortion analyzer for a zero dB reference.

Select the RIGHT ONLY position on the stereo source selector and, if required, adjust the zero dB reference on the distortion analyzer.

Select the LEFT ONLY position on the stereo source selector.

Using the input range controls on the distortion analyzer, measure the right channel separation.

Note: The COMP LF TILT adjustment affects both channels. Paragraphs 5 and 6 may be repeated several times to optimize this setting.

---

7. Stereo signal-to-noise ratio. This test should be run using the normal 75 μs de-emphasis characteristics of the stereo demodulator.

Connect the audio output of the distortion analyzer to the stereo source selector.

Set the stereo source selector to the LEFT + RIGHT position.

Using the 50 Hz high-pass filter, connect the left channel of the stereo demodulator to the distortion analyzer input.

Using the METER FUNCTION switch on the STL transmitter, select the PGM LVL position.

Adjust the output of the audio oscillator on the distortion analyzer for a frequency of 400 Hz.

Adjust the output level on the distortion analyzer so that the transmitter meter reads zero dB on the top scale.

Using the METER FUNCTION switch on the receiver, select the PGM LVL position, and verify that the meter reads within ±1 dB of the transmitter meter.

Adjust the input range and relative ADJ controls on the distortion analyzer for a zero dB reference on its meter.

Position the stereo source selector to the OFF position.

Measure the stereo demodulated signal-to-noise ratio for the left channel using the input range control on the distortion analyzer.

Using the 50 Hz high-pass filter, connect the input of the distortion analyzer to the right channel and repeat the test.

Troubleshooting

The performance of the stereo generator and stereo demodulator can be verified by connecting the output of the stereo generator directly to the input of the stereo demodulator.

5.3.8 Stereo Crosstalk

Description

The crosstalk measurements are made using a stereo generator of known quality, a low-distortion audio oscillator, and an audio spectrum analyzer.

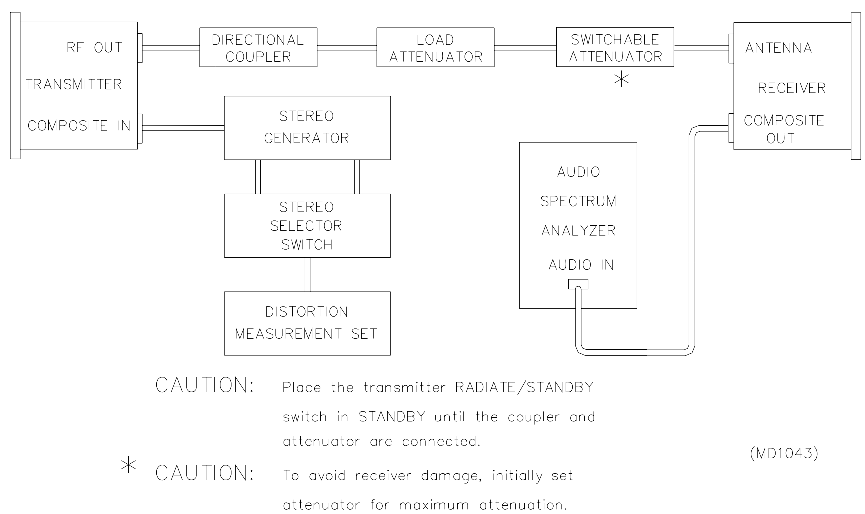


Figure 5-11
Stereo Crosstalk Setup

Procedure

1. Connect the equipment as shown in Figure 5-11. This test should be run with the stereo generator pre-emphasis switched out.

2. Set the OPERATE/STANDBY switch on the transmitter to the OPERATE position. The RADIATE status LED should be green.

   Using the METER FUNCTION switch, select the FWD PWR position, and verify that the meter of the transmitter reads between -3 and +2 dB on the top scale.

   Using the METER FUNCTION switch on the transmitter, select the PGM LVL position.

   Adjust frequency controls on the distortion analyzer for a value of 15 kHz.

   Adjust the oscillator output level on the distortion analyzer so that the transmitter meter reads zero dB on the top scale.

3. Using the METER FUNCTION switch on the receiver, select the RF LVL position.

   Position the switches of the adjustable attenuator so that the receiver meter reads between 1K and 3K on the middle scale.

   Using the METER FUNCTION switch on the receiver, select the PGM LEVEL position. Verify that the receiver meter reads between -1 and +1 dB on the top scale.

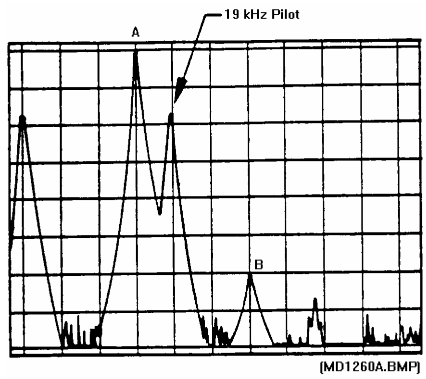
4. Position the controls on the audio spectrum analyzer as follows:

DOT MARKER	Dot on far left graticule
DOT FREQUENCY	Zero Hz
LOG	10 dB/DIV
SOURCE	Free run
MODE	NORM
RESOLUTION	Coupled
SPAN/DIV	5 kHz
TIME/DIV	AUTO
TERMINATION	1 Megohm
REF	dBV

5. Measure the stereo crosstalk as follows:
    a. Using the attenuator on the audio spectrum analyzer, adjust the 15 kHz waveform to the top graticule. (See Figure 5-12a.)
    b. Calculate the main channel to subchannel crosstalk by measuring the indicated waveforms and using the formula shown in Figure 5-12a.
    c. Adjust the frequency of the distortion measurement test set to 7.5 kHz.
    d. Position the stereo source selector to the left minus right position.
    e. Calculate the subchannel to main channel crosstalk by measuring the indicated waveforms and using the formula shown in Figure 5-12.

Troubleshooting

1. The stereo generator's performance can be verified by connecting output to the input of the audio spectrum analyzer and performing the tests specified in step 5 above.
2. If the STL link is identified as the source of excessive stereo crosstalk, the following steps should be taken:
    a. Verify that the cover is on the RF amplifier and install the covers on the transmitter and receiver using at least two screws.
    b. Ensure that the transmitter and receiver are more than 2 feet apart.
    c. Verify that distortion meets specification, using the procedure shown in paragraph 5.3.6.

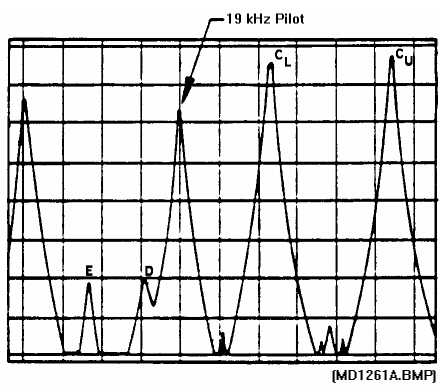


VERT = 10 dB/div, HOR = 5 kHz/div

A = 15 kHz L+R ref. level
B = 2nd harmonic distortion level at 30 kHz

Nonlinear crosstalk main to sub =
the difference in dB between level **A** and level **B** (60 dB in this example).

Figure 5-12a Nonlinear Crosstalk, Main to Sub



VERT = 10 dB/div, HOR = 5 kHz/div

C_L and **C_U** = lower and upper L-R sideband level at 30.5 kHz and 45.5 kHz.
D = intermodulation product at 15 kHz
E = linear (vector) crosstalk at 7.5 kHz; this signal is a product of the stereo generator

Nonlinear crosstalk sub to main = the difference in dB between level **C_L** or **C_U** and level **D** + 6 dB (60 dB in this example).

Figure 5-12b Nonlinear Crosstalk, Sub to Main

Nonlinear crosstalk: Measurement of the ratio in dB of harmonic products in the subchannel referred to 15 kHz L+R at 100% modulation in the main channel (M&S); measurement of the ratio in dB of intermodulation products in the main channel referred to 7.5 kHz L-R at 100% modulation in the subchannel (S&M).

5.3.9 STL Frequency Change

5.3.9.1 Quick Frequency Change Procedure

This simplified procedure is intended for users with prior experience in changing STL frequency. This guide covers the switch settings for the 950 MHz band products only. For frequencies not listed and for all other users refer to the detailed instructions that follow in Sections 5.3.9.2 for the transmitter and 5.3.9.3.

1. Remove RF Modules from respective units, transmitter and receiver. Remove the cover from component side of module.
2. Determine the switch settings from Table 5-2 “Frequency Selection Chart – 950 MHz Band” given below and set switches S0 to S3 accordingly on both transmitter and receiver RF Modules.

Table 5-2
Frequency Selection Chart – 950 MHz band

Channel Freq (MHz)	Receiver				Transmitter				Channel Freq (MHz)	Receiver				Transmitter			
	S0	S1	S2	S3	S0	S1	S2	S3		S0	S1	S2	S3	S0	S1	S2	S3
944	1	5	A	8	1	3	0	0	950	1	4	2	8	1	1	8	0
944.125	1	5	A	3	1	2	F	5	950.125	1	4	2	3	1	1	7	5
944.375	1	5	9	3	1	2	E	5	950.375	1	4	1	3	1	1	6	5
944.5	1	5	8	8	1	2	E	0	950.5	1	4	0	8	1	1	6	0
944.625	1	5	8	3	1	2	D	5	950.625	1	4	0	3	1	1	5	5
944.875	1	5	7	3	1	2	C	5	950.875	1	3	F	3	1	1	4	5
945	1	5	6	8	1	2	C	0	951	1	3	E	8	1	1	4	0
945.125	1	5	6	3	1	2	B	5	951.125	1	3	E	3	1	1	3	5
945.375	1	5	5	3	1	2	A	5	951.375	1	3	D	3	1	1	2	5
945.5	1	5	4	8	1	2	A	0	951.5	1	3	C	8	1	1	2	0
945.625	1	5	4	3	1	2	9	5	951.625	1	3	C	3	1	1	1	5
945.875	1	5	3	3	1	2	8	5	951.875	1	3	B	3	1	1	0	5
946	1	5	2	8	1	2	8	0	952	1	3	A	8	1	1	0	0
946.125	1	5	2	3	1	2	7	5	952.5	1	3	8	8	1	0	E	0
946.375	1	5	1	3	1	2	6	5	953	1	3	6	8	1	0	C	0
946.5	1	5	0	8	1	2	6	0	953.5	1	3	4	8	1	0	A	0
946.625	1	5	0	3	1	2	5	5	954	1	3	2	8	1	0	8	0
946.875	1	4	F	3	1	2	4	5	954.5	1	3	0	8	1	0	6	0
947	1	4	E	8	1	2	4	0	955	1	2	E	8	1	0	4	0
947.125	1	4	E	3	1	2	3	5	955.1125	1	2	E	3	1	0	3	5
947.375	1	4	D	3	1	2	2	5	955.5	1	2	C	8	1	0	2	0
947.5	1	4	C	8	1	2	2	0	956	1	2	A	8	1	0	0	0
947.625	1	4	C	3	1	2	1	5	956.1875	1	2	A	0	0	F	F	2
947.875	1	4	B	3	1	2	0	5	956.5	1	2	8	8	0	F	E	0
948	1	4	A	8	1	2	0	0	956.875	1	2	7	3	0	F	C	5
948.125	1	4	A	3	1	1	F	5	957	1	2	6	8	0	F	C	0
948.375	1	4	9	3	1	1	E	5	957.25	1	2	5	8	0	F	B	0
948.5	1	4	8	8	1	1	E	0	957.5	1	2	4	8	0	F	A	0
948.625	1	4	8	3	1	1	D	5	957.625	1	2	4	3	0	F	9	5
948.875	1	4	7	3	1	1	C	5	958	1	2	2	8	0	F	8	0
949	1	4	6	8	1	1	C	0	958.5	1	2	0	8	0	F	6	0
949.125	1	4	6	3	1	1	B	5	959	1	1	E	8	0	F	4	0
949.375	1	4	5	3	1	1	A	5	959.5	1	1	C	8	0	F	2	0
949.5	1	4	4	8	1	1	A	0	959.8	1	1	B	6	0	F	0	8
949.625	1	4	4	3	1	1	9	5	959.9375	1	1	B	0	0	F	0	2
949.875	1	4	3	3	1	1	8	5									

3. Put meter switch in AFC LVL position and adjust AFC for centerscale on the front panel meter. The test point/feedthrough marked “AFC LVL” on the RF Module should read +7 VDC.

> ***AFC Adjustment***
>
> ***F1 AFC ADJ** (C34) is enabled by switch **S4-2**. When enabled, LED indicator CR6—visible through the side of the module—will illuminate.*
>
> ***F2 AFC ADJ** (C30) is enabled by switch **S4-3.** When enabled, LED indicator CR5—visible through the side of the module—will illuminate.*
>
> ***Both adjustments are typically enabled at the same time**.*
>
> *C26 (fixed cap) is enabled by switch **S4-4**. Enable this switch when operating at **950 MHz or higher.***

4. **Transmitter:**
   Connect the transmitter dummy load/attenuated output to the frequency counter. Allow 5 minutes for the crystal oven to stabilize. Adjust 1st LO XTAL tuning capacitor C84 in the RF module to set the new output carrier frequency within 25 kHz of the switch setting.
5. **Receiver:**
   Adjust 70 MHz bandpass filter capacitors C41, C44, and C47 (IF Demod module, PCL6020) or C40, C43, C46, and C49 (Double Converter/LO3 module, PCL6030/6060) for a peak reading on the RF LVL meter position. These adjustments are found through access holes at the top of the module.
6. Put the cover back on the RF modules (they are a tight fit by design) and reinstall the modules in the transmitter and receiver.

5.3.9.2 Transmitter Procedure

Note: Check the schematics of the RF module pertaining to the frequency range of the system being modified. If the frequency change falls outside of the original range listed, the 1st LO crystal frequency must be changed. Consult the factory if this is the case.

(**Multichannel Option:** If this is a multichannel system, refer to Section 5.3.9.4)

1. Connect 50 ohm high power dummy load to transmitter RF output.
2. Remove RF Module from transmitter. Remove the cover from component side of module.
3.
   a. Calculate the FMO frequency as follows (check the system data sheet for the exact frequency):

For a High-Side LO (LO > CARRIER):

```
FMO frequency = (LO freq) - (CARRIER freq)
```

For a Low-Side LO (LO < CARRIER):

```
FMO frequency = (CARRIER freq) - (LO freq)
```

b. Program the synthesizer switches (S4-1, S1, S2, S3) in the RF module for the correct frequency.

   Please refer to the Synthesizer Frequency Calculation Example in Section 5.3.9.3.

4. Put meter switch in AFC LVL position and adjust AFC for centerscale on the front panel meter. The test point/feedthrough marked “AFC LVL” on the RF Module should read +7 VDC.

AFC Adjustment

F1 AFC ADJ *(C34) is enabled by switch* ***S4-2****. When enabled, LED indicator CR6—visible through the side of the module—will illuminate.*

F2 AFC ADJ *(C30) is enabled by switch* ***S4-3.*** *When enabled, LED indicator CR5—visible through the side of the module—will illuminate.*

Both adjustments are typically enabled at the same time and both tune AFC*.*

C26 (fixed cap) is enabled by switch ***S4-4****. Enable this switch when operating at* ***950 MHz or higher.***

5a. 950 MHz band: If the new frequency is within the 940–960 MHz range, there is no need to adjust the IPA and RFA filters. If the new frequency is outside of this range, peak the internal pc board mounted filters FL-12 and FL-11 for maximum IPA LVL meter reading. Peak the external filter FL2 (mounted underneath the Audio/Power Supply board) for maximum FWD PWR meter reading.

5b. 220–450 MHz band: Peak the external helical filter FL4 for maximum IPA LVL meter reading. Peak the external filter FL2 for maximum FWD PWR meter reading. Check the transmitter assembly drawing to verify the proper filter before tuning.

5c. 1.7 GHz band: The TX RF module operates at one-half the carrier frequency (i.e. 850 MHz for 1.7 GHz carrier). Peak the internal pc board mounted filters FL-12 and FL-11 for maximum IPA LVL meter reading. Peak the external filter FL2 (mounted in front of the RFA and part of the doubler assembly) for maximum FWD PWR meter reading.

6. Connect the transmitter dummy load output to the frequency counter. Allow 5 minutes for the crystal oven to stabilize. Adjust 1st LO XTAL tuning capacitor C84 in the RF module to set the new output carrier frequency.

   Note: Long-term crystal aging will usually result in an overall shift in LO frequency. Typically this shift will be less than 5 ppm (±5 kHz at 950 MHz) over the life of the radio

which is within acceptable performance and regulatory limits. On rare occasions this shift may be greater thereby exceeding allowable carrier frequency limits. It is therefore suggested to check LO frequency after 2 years of operation to verify it satisfies FCC guidelines.

7. Put the cover back on the RF module (it is a tight fit by design) and reinstall the module in the transmitter.

5.3.9.3 Receiver Procedure

Note: Check the schematics of the RF module pertaining to the frequency range of the system being modified. If the frequency change falls outside of the original range listed, the 1st LO crystal frequency must be changed. Consult the factory if this is the case.

(**Multichannel Option:** If this is a multichannel system, refer to Section 5.3.9.4)

1. Attenuate the carrier to 1500 μV and feed to the receiver antenna input.
2. Remove RF module from RX.
3. Remove cover from component side of module.

4a. Calculate the 2nd LO frequency as follows (check the system data sheet for the exact frequency):

For a High-Side LO (LO > CARRIER):

```
2nd LO freq = [(LO freq.) - (CARRIER freq)] + 10.7 MHz
```

For a Low-Side LO (LO < CARRIER):

```
2nd LO frequency = [(CARRIER freq) - (LO freq.)] + 10.7
MHz
```

4b. Program the synthesizer switches (S4-1, S1, S2, S3) in the RF module for the correct frequency.

Please refer to the Synthesizer Frequency Calculation Example in Section 5.3.9.3.

5. Put meter switch in AFC LVL position and adjust AFC for centerscale on front panel meter. The test point/feedthrough marked “AFC LVL” on the RF Module should read +7 VDC.
6. Reinstall RF Module.

AFC Adjustment

***F1 AFC ADJ** (C34) is enabled by switch **S4-2**. When enabled, LED indicator CR6—visible through the side of the module—will illuminate.*

***F2 AFC ADJ** (C30) is enabled by switch **S4-3.** When enabled, LED indicator CR5—visible through the side of the module—will illuminate.*

***Both adjustments are typically enabled at the same time and both tune AFC**.*

*C26 (fixed cap) is enabled by switch **S4-4**. Enable this switch when operating at **950 MHz or higher.***

7a. Preselector Filter (950 MHz, PCL6020/6030): Filters FL-12 and FL-11 (in the RF module) are two- and three-pole helical filters with a passband of approximately 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of the RF band used, is injected into RF IN and the signal is monitored at IF OUT. The five adjustments should be set for a flat passband greater than 5 MHz wide.

7b. Preselector Filter (950 MHz, PCL6060): The filter is located under the Audio/Power Supply board of the receiver (see system assembly drawing). The filter has a passband of approximately 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of the RF band used, is injected into RF IN and the signal is monitored at IF OUT. The five screw adjustments should be set for a flat passband greater than 5 MHz wide.

7c. Preselector Filter (220–450 MHz): The filter is located at the rear of the receiver (see system assembly drawing) and has a passband of approximately 8 MHz. This can be tuned by observing the RF LVL on the meter and peaking the three adjustment capacitors of the filter. Take care not to adjust the LO filter which is located on the same bracket. The preselector filter is the one that is connected directly to the ANTENNA port.

7d. Preselector Filter (1.7 GHz): The filter is located at the rear of the receiver (see system assembly drawing) and has a passband of approximately 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of the RF band used, is injected into RF IN and the signal is monitored at IF OUT. The five screw adjustments should be set for a flat passband greater than 5 MHz wide. Take care not to adjust the LO filter which is located on the same bracket. The preselector filter is the one that is connected directly to the ANTENNA port.

8. Adjust 70 MHz bandpass filter capacitors C41, C44, and C47 (IF Demod module, PCL6020) or C40, C43, C46, and C49 (Double Converter/LO3 module, PCL6030/6060) for a peak reading on the RF LVL meter position. These adjustments are found through access holes at the top of the module.

5.3.9.4 System Check

1. Using MOD ADJ (R33) in the transmitter RF module, set deviation to ±50 kHz (±40 kHz mono).

2. Using a 15 kHz tone, verify distortion is within specification. (If adjustment is needed, use 10.7 MHz IF adjustments.)

Synthesizer Frequency Calculation Example

Multichannel Option:
If this is a multichannel system, refer to Section 5.3.9.4.

Step 1. If larger than 64 MHz, put S4-1 in "1" position and go to step 3.

Step 2. Subtract 64 MHz from synthesizer frequency:

95.600 MHz (example frequency)= f

95.600
-64.000
31.600 MHz = **result "A"**

Step 3. See Table 5-2 below, S1 column. Find largest entry which is less than or equal to result "A":

28.0 $\leq$ 31.6, therefore S1 = 7

Step 4. Subtract S1 frequency from result "A":

31.00 MHz
-28.00
3.600 MHz = **result "B"**

Step 5. See Table 5-2 below, S2 column. Find largest entry which is less than or equal to result "B":

3.50 $\leq$ 3.60, therefore S2 = E

Step 6. Subtract S2 frequency from result "B":

3.600 MHz
-3.500
.100 MHz = **result "C"**

Step 7. See Table 5-2 below, S3 column. Find largest entry which is less than or equal to result "C".

.100 $\leq$ .100, therefore S3 = 4

Step 8. Any remainder is obtained by offsetting the reference oscillator.

Figure 5-13
Synthesizer Frequency Calculation Example

5.3.9.5 Multichannel Option

The Multichannel System has been aligned to operate within the programmed channel frequency bandwidth specified for your system. To operate at another non-programmed frequency, be sure it is within the existing bandwidth of your system. The system data sheets supplied with your unit

contain valuable information for alignment and frequency changes in the field. Be sure to have these at hand when contacting Moseley.

NOTE

Any user adjustments to the AFC level in the RF module and/or the IF filters in the IF strip will change the factory presets for the existing programmed channels. Re-adjustment can be very difficult to achieve. Consult the factory for best results.

Table 5-3
Synthesizer Frequency Selection Switch Settings

S1	MHz	S2	MHz	S3	MHz
0	0.0	0	0.0	0	0.0
1	4.0	1	0.25	1	0.025
2	8.0	2	0.50	2	0.050
3	12.0	3	0.75	3	0.075
4	16.0	4	1.00	4	0.100
5	20.0	5	1.25	5	0.125
6	24.0	6	1.50	6	0.150
7	28.0	7	1.75	7	0.175
8	32.0	8	2.00	8	0.200
9	36.0	9	2.25	9	0.225
A	40.0	A	2.50	A	0.250
B	44.0	B	2.75	B	0.275
C	48.0	C	3.00	C	0.300
D	52.0	D	3.25	D	0.325
E	56.0	E	3.50	E	0.350
F	60.0	F	3.75	F	0.375

5.3.10 FMO Adjustment

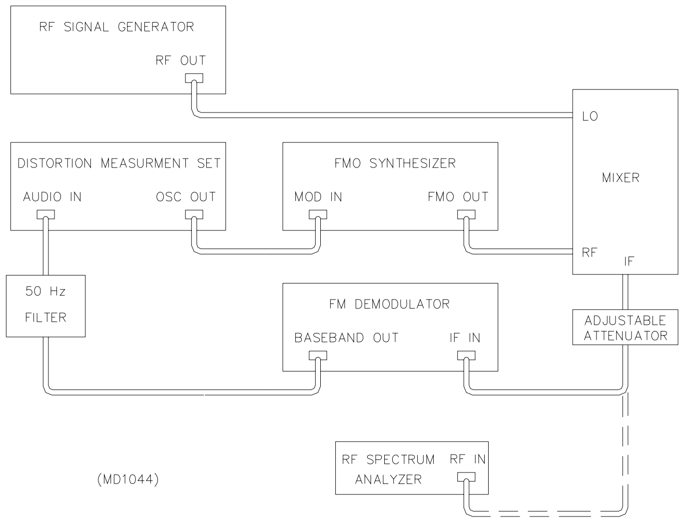


Figure 5-14
Test Setup for FMO Adjustment

Procedure

1. a. Connect the equipment as shown in Figure 5-14.

   b. Using the counter, measure the output frequency of the FMO.

   For a High-Side LO (LO > CARRIER):

   FMO frequency = (LO freq) - (CARRIER freq)

   For a Low-Side LO (LO < CARRIER):

   FMO frequency = (CARRIER freq) - (LO freq)

Note: If the frequency is greater than 10 kHz away from the desired frequency, remove the top cover and position frequency selector switches (S4-1, S1, S2, S3) for the desired frequency.

2. Adjust the 1st LO XTAL tuning capacitor C84 so that the counter reads the desired frequency.

Note: If the FMO LOSS OF LOCK is red, it will be necessary to first adjust the AFC level to accomplish this step. See Step 4 below.

3. Reconnect the FMO output to the RF input of the mixer.
4. Adjust the controls on the RF signal generator for a frequency that is 70 MHz (PCL6020) or 3 MHz (PCL6030/6060) above the FMO frequency and for an output of +10 dBm.

Using the RF spectrum analyzer, position the switches on the adjustable attenuator for an output level of between -20 and -25 dBM at 70 MHz.

Reconnect the adjustable attenuator to the IF Demod.

5. Adjust the oscillator output on the distortion measurement test set for a frequency of 1 kHz and a level of 1.25 VRMS (3.5 Vp-p).

6. Distortion and AFC Level Alignment.

> ### *AFC Adjustment*
>
> ***F1 AFC ADJ*** *(C34) is enabled by switch* ***S4-2****. When enabled, LED indicator CR6—visible through the side of the module—will illuminate.*
>
> ***F2 AFC ADJ*** *(C30) is enabled by switch* ***S4-3.*** *When enabled, LED indicator CR5—visible through the side of the module—will illuminate.*
>
> ***Both adjustments are typically enabled at the same time and tune AFC****.*
>
> *C26 (fixed cap) is enabled by switch* ***S4-4****. Enable this switch when operating at* ***950 MHz or higher.***

Using the multimeter, monitor FL1 (AFC Level) and adjust AFC so that the voltmeter reads +7 VDC.

Using the distortion measurement test set, verify that the baseband output of the IF Demod is between 1.0 and 1.5 V_{RMS}.

Measure the distortion of the output of the IF Demod, and adjust the Varicap Bias adjustment on the FMO (R37) for a minimum distortion reading.

Note: Normally there are two setting of the Varicap Bias adjustment that will obtain distortion minima. Varicap bias should be adjusted to that setting which produces the lowest distortion.

Readjust the AFC so that the voltmeter reads 7 volts.

Repeat this procedure until the varicap bias is set for minimum distortion and the AFC level adjustment is between 6.9 and 7.1 VDC.

Set the frequency on the distortion measurement test set for 15 kHz and verify that the distortion meets specifications.

7. Modulation Level.

The deviation select jumper E7 on the receiver Audio/Power Supply should be in the wideband composite position.

Using the counter, set the output frequency of the distortion measurement test set oscillator to 20.78 kHz (16.62 kHz mono). Verify that the oscillator output voltage is 1.25 VRMS (1.00 VRMS mono).

Adjust FMO deviation for ± 50 kHz (± 40 kHz mono) as follows, using the Bessel null function waveforms in Figure 5-5:

a. Connect the output of the adjustable attenuator to the RF spectrum analyzer and disconnect the audio input from the FMO. Establish the reference level shown in Figure 5-5 on the RF spectrum analyzer.

b. Reconnect the audio from the distortion measurement test set to the FMO and adjust the MODULATION ADJ (R33) on the FMO from minimum to the first Bessel null function (Figure 5-5b).

8. Reconnect the adjustable attenuator to the IF Demod.

   Verify the AFC level at FL1 is between 6.9 and 7.1 VDC.

   Verify the distortion at 15 kHz meets specifications.

   Repeat Steps 6 through 8 of this procedure as required to achieve the above results.

9. Using the Power Meter, verify that the output of the FMO is -2 ± 2 dBm.

5.3.11 Transmitter Troubleshooting Procedure

Procedure:

1. Connect the equipment as shown in Figure 5-1 and position the OPERATE/STANDBY switch in the OPERATE position.
2. Check the +5 VDC, +15 VDC, -15 VDC, -12 VDC, and +12.5 VDC test points on the Audio/Power Supply board.
3. Verify that the RADIATE and AFC LOCK status indicators are green. The AFC LOCK indicator is controlled by the FMO. The RADIATE status indicator is determined by the Radiate Control circuitry.
4. The following test points on the Audio/Power Supply board should be checked:

   a. AFC LVL: The AFC Level should be between 6.9 VDC and 7.1 VDC. If not, the FMO AFC Level should be aligned before proceeding (see Section 5.3.10).

   b. IPA: The IPA Level should be greater than 1 VDC. If not, the following steps should be taken:

   Verify that the +12 VDC is between +12.25 and +12.75 VDC.

   Using the power meter, verify that the input to the IPA amplifier is at least -10 dBm. If it is, the problem is located in the IPA amplifier.

   Measure the output of the 1st LO and module for a value of between +5 and +10 dBm.

   Using the power meter, measure the output of the FMO for a value of -2 ±2 dBm.

5.4 Module Adjustments Information

This section provides additional technical information to assist during alignment troubleshooting and module replacement.

Included are adjustment instructions to be used during troubleshooting, module repair, or module replacement for the following modules:

- 5.4.1 Transmitter Audio/power Supply
- 5.4.2 Transmitter RF Module
- 5.4.3 Doubler assembly (1.7GHz)
- 5.4.4 RF Amplifier
- 5.4.5 Receiver Audio/Power supply
- 5.4.6 Receiver RF Module
- 5.4.7 IF Demod (PCL6020)
- 5.4.8 Double Converter/LO3 (PCL6030/6060)
- 5.4.9 Preamp/1st Mixer (950 MGz, PCL6060)
- 5.4.10 FM Demod (PCL6030/6060)
- 5.4.11 Adjacent Channel Filter (PCL6060)
- 5.4.12 Channel Control Board (Multichannel Option)

5.4.1 Transmitter Audio/Power Supply

AUDIO PROCESSOR

COMP PGM LVL (R28)	Composite program level adjustment. Sets the transmitter deviation of the composite signal. Normal input is 3.5 V_{p-p}. The normal deviation of the transmitter is ±50 kHz.
MONO PGM LVL (R199)	Monaural program level adjustment. Sets the transmitter deviation of the mono signal. Normal input is +10 dBm. The normal deviation of the transmitter is ±40 kHz.
DIG PGM LVL (R200)	Digital modulation program level adjustment. Sets the transmitter deviation of the digital signal in DSP6000 applications. Consult the DSP6000 manual for further information.
MUX1 LVL (R29)	MUX (ch. 1) level adjustment. Sets the transmitter deviation for the MUX (ch. 1) deviation. The normal input is 1.5 V_{p-p} at 110 kHz. Main carrier deviation normally is ±5 kHz.
MUX2 LVL (R40)	MUX (ch. 2) level adjustment. Sets the transmitter deviation for the MUX (ch. 2) input. The normal input is 1.5 V_{p-p} at 185kHz. Main carrier deviation normally is ±7.5 kHz.
PHASE SELECT (E2)	Jumper used to select the phase of the modulation. Position A is in-phase and position B is 180 degrees out-of-phase.

MONO LVL SELECT(E6)	Hard-wire jumper used to select various input levels and impedances. See the table referenced in the schematic.
75 µs PRE-EMPHASIS (E5)	Jumper to enable (IN) or disable (OUT) the pre-emphasis network (E5) (mono only).
F1 (R77)	Adjustment for lower break frequency of pre-emphasis (factory set).
F2 (R78)	Adjustment for upper break frequency of pre-emphasis (factory set).
15 kHz LPF (E4)	Jumper select for monaural low-pass filter (IN/OUT).
FA (R76)	Monaural 15 kHz low-pass filter adjustments (factory set).
FB (R75)	Monaural 15 kHz low-pass filter adjustments (factory set).
FC (R49)	Monaural 15 kHz low-pass filter adjustments (factory set).
LF TILT (R47)	Compensates for low frequency roll-off of mono filter (factory set).
LPF GAIN (R45)	Sets unity gain of mono filter.
MONO/COMP SELECT (E3)	Selects the input program signal to be processed.

METERING

COMP PGM MTRG(R201)	Composite PGM LVL meter function. 0 dB = 50 kHz deviation.
MONO PGM MTRG(R202)	Monaural PGM LVL meter function. 0 dB = 40 kHz deviation.
DIG PGM MTRG (R203)	Digtial modulation PGM LVL meter function.
REFL-PWR (R161)	REFL PWR meter function. 0 dB = 100% reflected power.
FWD-PWR (R162)	FWD PWR meter function. 0 dB = 100% output power (5 to 7 watts).
PA-CURR (R163)	RF Power Amp current meter function. Scale is AMPS X 10.
IPA-LVL (R164)	Intermediate power amplifier relative output level meter function.
AFC-LVL (R165)	Relative AFC level from FMO/synthesizer meter function.
LO1 (R166)	Relative output level of 1st LO meter function.
MUX (R159)	MUX LVL meter function. 5 on the lower scale equals 5 kHz deviation of the main carrier by the subcarrier.
+5V (R157) +12V (R155) +15V (R151) -15V (R153)	Power supply metering adjustments.
METER BALLISTICS (R286)	Adjust the meter ballistics. The meter is normally adjusted for a 0.25 dB overshoot by switching between the REFL POWER meter function and the PGM LEVEL meter function with a 0 dB input (program input = 3.5 V_{p-p} or 1.25 V_{RMS}).
METER ZERO (R131)	Used to electrically zero the meter.

POWER SUPPLY

+12 V ADJ (R6)	Used to adjust the +12.5 VDC (+22 VDC for 1.7 GHz) power supply output voltage when the transmitter is in the OPERATE position.

CONTROL

TPT THRESHOLD (R138)	Sets the point at which the standby transmitter will switch in conjunction with the Moseley TPT-2 transfer panel.

5.4.2 Transmitter RF Module

FMO SYNTHESIZER

REF FREQ ADJ (OSC1)	Frequency Trim Adjustment. Used to tune the reference oscillator.
LOSS OF LOCK (CR1)	This LED gives a red indication when the AFC loses lock.
AFC LVL (FL1)	AFC level test point. Monitors the DC level of the AFC loop. It is normally set to +7 VDC.
VARICAP BIAS (R37)	Varicap bias adjustment. Used to adjust the FMO for minimum distortion.
VARICAP BIAS (TP4)	Varicap bias level test point. A DC level (-5.5 VDC) to set a nominal minimum distortion point.
MOD ADJ (R33)	Modulation adjustment. Used to set the FMO deviation. It is normally set to ± 40 kHz with 2.8 V_{p-p} input.
F1 AFC ADJ (C34)	F1 AFC Level Adjustment. Adjusted for a nominal 5–9 VDC depending on the channel assignment. Check the test data sheet.
F1 “ON” (S4-2)	Switches on the F1 AFC adjustment capacitor (active).
F1 LED (CR6)	Indicates the F1 AFC adjustment capacitor is active.
F2 AFC ADJ (C30)	F2 AFC Level Adjustment. Adjusted for a nominal 5–9 VDC depending on the channel assignment. Check the test data sheet.
F2 “ON” (S4-3)	Switches on the F2 AFC adjustment capacitor (active).
F2 LED (CR5)	Indicates the F2 AFC adjustment capacitor is active.
FIX “ON” (S4-4)	Switches on the FIX AFC adjustment capacitor (active).
FMO LVL (TP2)	FMO level test point. A DC level (+0.9 VDC) that represents the detected relative output of the FMO oscillator.

FREQUENCY SELECTOR SWITCHES

S4-1	Programs the 64 MHz step size of the synthesizer.
S1	Programs the 4 MHz step size of the synthesizer.
S2	Programs the 250 kHz step size of the synthesizer.
S3	Programs the 25 kHz step size of the synthesizer.

INTERMEDIATE POWER AMPLIFIER (950 MHZ)

The only adjustments to the IPA are the filters (FL11, FL12). These can be adjusted by injecting a sweep signal at J3 with P2 in the “test-out” position. The filter response may be tuned by observing the output on a spectrum analyzer. If a quick alignment is needed, put the meter switch in IPA position and peak the reading by adjusting the filter screws. P2 should be in the operate position for this.

INTERMEDIATE POWER AMPLIFIER (220–450 MHZ)

The only adjustments to the IPA are the external filters (FL4, FL2). These can be adjusted by tuning the filter screws for a peak reading of the FWD PWR meter while in the OPERATE mode.

1ST LOCAL OSCILLATOR (950 MHZ)

XTAL OSC TUNE (C84)	Crystal oscillator tune. Sets peak oscillator output and operating point.
DRIVER TUNE (C88)	Sets input level to the doubler for maximum odd harmonic rejection.
SRD INPUT MATCH1 (C95)	Diode drive adjustment. Used to tune for maximum power output.
SRD INPUT MATCH2 (C98)	Diode drive adjustment. Used to tune for maximum power output.
SRD OUTPUT MATCH1(C65)	Diode match adjustment. Used to tune for maximum power output.
SRD OUTPUT MATCH2(C101)	Diode match adjustment. Used to tune for maximum power output.
LO FILTER (FL10)	Factory set for 20 MHz bandwidth. DO NOT ADJUST.
LO LVL (FL3)	Detected DC level (+1.5 VDC) representing power output of LO.

Note: When installed in the PCL6010 transmitter, set for the 950 MHz band, the frequency output of this module should be 1020 MHz with a power output between +5 and +9 dBm. This measurement should be made on a low-power wattmeter.

1ST LOCAL OSCILLATOR (330/450 MHZ)

XTAL OSC TUNE (C84)	Crystal oscillator tune. Sets peak oscillator output and operating point.
DRIVER TUNE (C88)	Sets input level to the doubler for maximum odd harmonic rejection.
SRD INPUT MATCH1 (C95)	Diode drive adjustment. Used to tune for maximum power output.
SRD INPUT MATCH2 (C98)	Diode drive adjustment. Used to tune for maximum power output.
SRD OUTPUT MATCH (C101)	Diode match adjustment. Used to tune for maximum power output.
LO FILTER (EXT)	External LO filter. Tune for maximum power output.
LO LVL (FL3)	Detected DC level (+1.5 VDC) representing power output of LO.

5.4.3 Doubler Assembly (1.7 GHz)

The only adjustments to the Doubler Assembly are in the filter (FL2). The filter can be adjusted by injecting a sweep signal into FL2. The filter response may be tuned by observing the output on a spectrum analyzer. If a quick alignment is needed, put the meter switch in the FWD PWR position and peak the reading by adjusting the filter screws.

5.4.4 RF Amplifier

5.4.4.1 Alignment Procedure (950 MHz)

1. Measure input level at the RFA. It should be greater than +13 dBm and less than +19 dBm (damage level). If power level is low, peak the external RFA filter.

2. Connect RFA output to power meter and spectrum analyzer using an appropriate high power attenuator/dummy load.
3. Connect input and adjust R1 (1st stage bias) through access hole in RFA for 6 watts (+38 dBm).
4. Monitor PA final current sample voltage across C701 and C702. Calculate (final current = Vsample divided by 0.16). Current should be < 1.7 amp.
5. Check harmonic and spurious signal content for level ≤ -65 dBc.

5.4.4.2 Alignment Procedure (450 MHz)

1. Measure input level at the RFA. It should be greater than +18 dBm and less than +23 dBm (damage level). If power level is low, peak the external RFA filter.
2. Connect RFA output to power meter and spectrum analyzer. Using appropriate high power attenuator/dummy load.
3. Connect input and adjust RFA power supply +12.5 ADJ for 10 watts (+40 dBm).
4. Monitor final current for reading < 2.0 amp.
5. Check harmonic and spurious signal content for level ≥ 65 dBc.

5.4.4.3 Alignment Procedure (330 MHz)

1. Measure input level at the RFA. It should be 20 dBm (100 mW nominal). If power level is low, peak the external RFA filter.
2. Connect RFA output to power meter and spectrum analyzer using appropriate high power attenuator/dummy load.
3. Connect input and adjust C701, C703 and C707 for max output power.
4. Adjust C712 and C713 for maximum output power, minimum final stage current and harmonic/spurious content ≥ 65 dBc.
5. Maximum final current must be < 1.7 amp.

5.4.4.4 Alignment Procedure (220 MHz)

1. Measure input level at the RFA. It should be 20 dBm (100 mW nominal). If power level is low, peak the external RFA filter.
2. Connect RFA output to power meter and spectrum analyzer using appropriate high power attenuator/dummy load.
3. Connect input and adjust C701, C703, and C707 for max output power.
4. Adjust C712 and C713 for maximum output power, minimum final stage current and harmonic/spurious content ≥ 65 dBc.
5. Maximum final current must be < 1.7 amp.

5.4.4.5 Alignment Procedure (1.7 GHz)

CAUTION

Do not attempt to adjust this RFA. Call the factory for any technical problems encountered with this module.

5.4.5 Receiver Audio/Power Supply

AUDIO PROCESSOR

COMP/MONO SELECT	Jumpers (E1, E4, E5, E6, E7, E8, E10) select proper audio processing and MUX filter bands for either composite or monaural operation.
COMP FILTER (E9)	Jumper E9 bypasses the composite low pass filter and delay equalizer (OUT position) for digital STL applications (see DSP6000 manual for further details.
COMP HF TILT (R7)	High frequency tilt adjustment (composite). Compensates for the high frequency roll-off caused by the IF filtering.
MONO HF TILT (R208)	High frequency tilt adjustment (monaural). Compensates for the high frequency roll-off caused by the IF filtering.
COMP LF TILT (R61)	Composite low frequency tilt adjustment. Adjusts the stereo separation between 30 and 100 Hz.
DELAY EQ (R111)	Delay Equalizer Adjustment. Adjusts the stereo separation between 10 and 15 kHz.

Note: The COMP HF TILT, COMP LF TILT, and DELAY EQ adjustments are used primarily to optimize stereo separation performance. In other applications, such as communications, HF TILT and LF TILT would be used to adjust the audio frequency response within ± 1 dB from 30 Hz to 53 kHz. The DELAY EQ adjustment would have no effect on the frequency response performance.

75 µs DE-EMPHASIS	Jumper selects the de-emphasis network to be enabled SELECT (E2) (IN) or disabled (OUT).
F1 (R23)	Adjustment for lower break frequency of de-emphasis (factory set).
F2 (R22)	Adjustment for upper break frequency of de-emphasis (factory set).
15 kHz LPF (E3)	Jumper select for monaural low-pass filter.
FA (R30)	Monaural 15 kHz low-pass filter adjustments (factory set).
FB (R78)	Monaural 15 kHz low-pass filter adjustments (factory set).
FC (R82)	Monaural 15 kHz low-pass filter adjustments (factory set).
MONO LF TILT (R88)	Compensates for low frequency roll-off of mono filter (factory set).
FILTER GAIN (R89)	Sets unity gain of mono filter.
MONO PGM LVL (R98)	Sets output program level of the receiver.
MONO PGM MTRG (R90)	Sets the meter program level for mono operation.
MUX LVL (R12)	MUX level adjustment. Adjusts the MUX level output of the audio processor. Normally adjusted so that ± 5 kHz (± 4 kHz mono) deviation equals 1.5 V_{p-p} at 110 kHz.

METERING AND STATUS

PGM LVL (R171)	Adjusts the PGM LEVEL meter function. 100% = 0 dB.
AFC LVL (R166)	AFC level metering adjust. Center arc.
LO1 (R169)	1st LO relative level. Center arc.
LO2 (R168)	2nd LO/synthesizer relative level. Center arc.
LO3 (R167)	3rd LO relative level (PCL6030). Center arc.
MUX LVL (R170)	Adjusts the MUX LVL function of the meter. A reading of 5 on the lower scale equals 5 kHz of the main carrier by the subcarrier.
SIG LVL (R172)	Used to adjust the RF LEVEL function. A reading of 3 K on the center scale of the meter equals 3000 μV of input signal.
+5V (R213) +15V (R210) -15V (R212)	Power supply metering adjustments.
METER BALLISTICS (R196)	Adjusts the meter ballistics.
METER ZERO (R186)	Adjusts meter zero.

MUTE AND TRANSFER

The Mute and Transfer section requires no adjustment. If a failure is suspected in the Mute and Transfer circuitry, the following information may be useful in isolating the problem:

1. A mute signal from the IF Demod (Mute Threshold Adjust LED red) will de-energize the mute relay and disconnect the composite and MUX audio outputs.
2. This module may be externally muted, either by a remote mute input or a transfer input from a receiver transfer panel (TPR).

5.4.6 Receiver RF Module

PRESELECTOR FILTER (950 MHZ, PCL6020/6030)

Filters FL-12 and FL-11 (in the RF module) are two- and three-pole helical filters with a passband of approximately 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of the RF band used, is injected into RF IN and the signal is monitored at IF OUT. The five adjustments should be set for a flat passband greater than 5 MHz wide.

PRESELECTOR FILTER (950 MHZ, PCL6060)

The filter is located under the Audio/Power Supply board of the receiver (see system assembly drawing). The filter has a passband of approximately 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of the RF band used, is injected into RF IN and the signal is monitored at IF OUT. The five screw adjustments should be set for a flat passband greater than 5 MHz wide.

PRESELECTOR FILTER (220–450 MHZ)

The filter is located at the rear of the receiver (see system assembly drawing) and has a passband of approximately 8 MHz. This can be tuned by observing the RF LVL on the meter and peaking the three adjustment capacitors of the filter. Take care not to adjust the LO filter which is located on the same bracket. The preselector filter is the one that is connected directly to the ANTENNA port.

PRESELECTOR FILTER (1.7 GHZ)

The filter is located at the rear of the receiver (see system assembly drawing) and has a passband of approximately 20 MHz. Under normal circumstances, no alignment is required. To check alignment, a sweep oscillator, whose frequency is centered in the middle of the RF band used, is injected into RF IN and the signal is monitored at IF OUT. The five screw adjustments should be set for a flat passband greater than 5 MHz wide. Take care not to adjust the LO filter which is located on the same bracket. The preselector filter is the one that is connected directly to the ANTENNA port.

1ST LOCAL OSCILLATOR (950 MHZ)

The adjustments for the receiver 1st LO are identical to those specified for the transmitter 1st LO (see Section 5.4.2).

1ST LOCAL OSCILLATOR (330/450 MHZ)

The adjustments for the receiver 1st LO are identical to those specified for the transmitter 1st LO (see Section 5.4.2).

LO2 SYNTHESIZER

REF FREQ ADJ (OSC1)	Frequency Trim Adjustment. Used to tune the reference oscillator.
LOSS OF LOCK (CR1)	This LED gives a red indication when the AFC loses lock.
AFC LVL (FL1)	AFC level test point. Monitors the DC level of the AFC loop. It is normally set to +7 VDC.
F1 AFC ADJ (C34)	F1 AFC Level Adjustment. Adjusted for a nominal 5–9 VDC depending on the channel assignment. Check the test data sheet.
F1 “ON” (S4-2)	Switches on the F1 AFC adjustment capacitor (active).
F1 LED (CR6)	Indicates the F1 AFC adjustment capacitor is active.
F2 AFC ADJ (C30)	F2 AFC Level Adjustment. Adjusted for a nominal 5–9 VDC depending on the channel assignment. Check the test data sheet.
F2 “ON” (S4-3)	Switches on the F2 AFC adjustment capacitor (active).
F2 LED (CR5)	Indicates the F2 AFC adjustment capacitor is active.
FIX “ON” (S4-4)	Switches on the FIX AFC adjustment capacitor (active).
LO2 LVL (TP2)	LO2 level test point. A DC level (+0.9 VDC) that represents the detected relative output of the FMO oscillator.

FREQUENCY SELECTOR SWITCHES

S4-1	Programs the 64 MHz step size of the synthesizer.
S1	Programs the 4 MHz step size of the synthesizer.
S2	Programs the 250 kHz step size of the synthesizer.
S3	Programs the 25 kHz step size of the synthesizer.

5.4.7 IF Demod (PCL6020)

1ST 10.7 MHz IF ADJ (C13)	IF Adjustment. Adjust for minimum distortion.
2ND 10.7 MHz IF ADJ (C18)	IF Adjustment. Adjust for minimum distortion.

Note: The L02 FREQ ADJ and the 1st 10.7 MHZ IF ADJ and 2nd 10.7 MHz IF ADJ interact. See paragraph 5.3.6, Distortion Alignment, for additional information.

70 MHz BPF ADJ (C41,C44,C47)	Bandpass Filter Adjustments. The alignment of the 70 MHz bandpass filter can be checked indirectly by verifying the receiver noise performance to within 20 μV of the value specified on the final test data sheet included in this manual. (See paragraph 5.3.2, Receiver Sensitivity).
MUTE THRESHOLD (R18)	Mute Threshold Adjust. Adjusts the mute logic threshold; threshold = 20 μV input signal.
BB LVL ADJ (R19)	Baseband Level Adjust. Adjust the output of the baseband including the composite and MUX levels. ±50 kHz deviation = 3.5 V_{p-p}.
BB LVL (TP2)	Baseband Level Test Point. An AC test point used to monitor the output level of the baseband processor. ±50 kHz deviation = 3.5 V_{p-p}.
DEMOD BALANCE (TP1)	Demod Balance Level. Is an indication of quadrature coil balance (minimum distortion) and/or demodulator free drift (0 ± 1 VDC).

5.4.8 Double Converter/LO3 (PCL6030/6060)

70 MHz BPF ADJ (C40,C43,C46,C49)	Bandpass Filter Adjustments. The alignment of the 70 MHz bandpass filter can be checked indirectly by verifying the receiver noise performance to within 20 μV of the value specified on the final test data sheet included in this manual. (See paragraph 5.3.2, STL Receiver Sensitivity.
1ST IF FLTR SELECT (E2,E3)	Selects proper filter for intended system application.
1ST 10.7 MHz IF ADJ WB (C14)	Wideband IF Filter Adjust. Determines selectivity and distortion specifications.
1ST 10.7 MHz IF ADJ NB (C15)	Narrowband IF Filter Adjust. Determines selectivity and distortion specifications.
1ST 10.7 MHz IF ADJ MONO (C13)	Mono IF Filter Adjust Determines selectivity and distortion specifications.
2ND IF FLTR SELECT (E4,E5)	Selects proper filter for intended system application.
2ND 10.7 MHz IF ADJ COMP	Composite IF Filter Adjust. Determines selectivity and distortion (C21) specifications.
2ND 10.7 MHz IF ADJ MONO	Mono IF Filter Adjust. Determines selectivity and distortion (C22) specifications.
LO3 OUT LVL (FL6)	LO3 Output Level. DC voltage sample of 3rd LO at 13.7 MHz (0.3–1.2 VDC).

5.4.9 Preamp/1st Mixer (950 MHz, PCL6060)

RF ATTEN ADJ (R13)	Sets the value of front end attenuation (up to 15 dB).

RF ATTEN LVL (TP1)	Indication of relative attenuation (0 VDC = max atten.).
70 MHZ OUTPUT ADJ (L3)	Set for peak level of 1st IF output in this module.

5.4.10 FM Demod (PCL6030/6060)

LOG GAIN ADJ (R67)	Log Gain Adjustment. Calibrates the RF LVL meter function. With 10 mV of signal applied to the RF input, SIG LVL on the Audio/Power Supply board should be adjusted for a reading of 3K on the middle scale. The input should then be reduced to 100 mV, and the LOG GAIN ADJ on the FM Demod should be adjusted for 100 on the middle scale. The 3, 10, 30, 100, 300, 1 K, and 3 K levels should be checked to ensure that the meter reads between the upper and lower line on the meter for each range. As a general rule, SIG LVL is used to adjust the full scale or 3 K reading, and the LOG GAIN ADJ on the FM Demod module is used to adjust the linearity in the 100 to 300 mV range.
LOG LVL (TP3)	Log Level Test Point. A DC test point used to monitor the first stage of the meter log amplifier.
DEMOD LVL (TP2)	Demod Level Test Point. A DC test point with a voltage proportional to the frequency of the 3 MHz IF. Normally, this voltage is between +4 and +6 VDC.
MUTE INDICATOR (CR6)	Mute Threshold Indicator (LED). Indicates status of mute logic (red = mute).
MUTE THRESHOLD ADJ (R22)	Mute Threshold Adjust. Adjusts the mute logic threshold; threshold = 20 mV input signal with RF gain at 15 on receiver meter.
BB LVL ADJ (R10)	Baseband Level Adjust. Adjust the output of the baseband including the composite and MUX levels. ±50 kHz deviation wideband or ±35 kHz deviation narrowband = 3.5 V_{p-p}.
BB LVL (TP1)	Baseband Level Test Point. An ac test point used to monitor the output level of the baseband processor. ±50 kHz deviation wideband or ±35 kHz deviation narrowband = 3.5 V_{p-p}.

5.4.11 Adjacent Channel Filter (PCL6060)

COMP/MONO SELECT (E1,E2)	Selects proper filter for intended system application (Composite or Mono).

5.4.12 Channel Control Board (Multichannel Option)

CHNL SELECT (S1)	Front panel select control. Selects channels 0–15.
FIX LED (CR1)	LED indicates EPROM output bit C5 (FIX capacitor in RF Module) is active.
F2 LED (CR2)	LED indicates EPROM output bit C4 (F2 capacitor in RF Module) is active.
F1 LED (CR3)	LED indicates EPROM output bit C3 (F1 capacitor in RF Module) is active.
MOD1 LED (CR4)	LED indicates EPROM output bit C2 (MOD1 adjustment) is active.

MOD2 LED (CR5)		LED indicates EPROM output bit C1 (MOD2 adjustment) is active.
MOD3 LED (CR6)		LED indicates EPROM output bit C0 (MOD3 adjustment) is active.
DGT1 TEST (E1)		Short circuit this test point to turn on all segments (display **“8”**) of DGT1.
MOD IN (TP1)		Modulation input to control board (3.5 V_{p-p} nominal).
MOD1 LVL ADJ (R12)		Modulation adjustment (1) set active by EPROM or CHNL ZERO programming.
MOD2 LVL ADJ (R13)		Modulation adjustment (2) set active by EPROM or CHNL ZERO programming.
MOD3 LVL ADJ (R14)		Modulation adjustment (3) set active by EPROM or CHNL ZERO programming.
MOD OUTPUT (TP2)		Modulation output to transmitter RF Module (3.5 V_{p-p} nominal).
INTERNAL REMOTE		
ENABLE	(S6-1)	When set to ON, provides internal **front panel lockout** of the channel select function.
CHNL SELECT	(S6-2)	BCD 8's bit to set channel number when INT RMT ENABLE is ON. 1=8
	(S6-3)	BCD 4's bit to set channel number when INT RMT ENABLE is ON. 1=4
	(S6-4)	BCD 2's bit to set channel number when INT RMT ENABLE is ON. 1=2
	(S6-5)	BCD 1's bit to set channel number when INT RMT ENABLE is ON. 1=1
CHANNEL ZERO PROGRAMMING		
FIX	(S2-1)	Sets FIX capacitor in RF Module active. 1=ON
F2	(S2-2)	Sets F2 capacitor in RF Module active. 1=ON
F1	(S2-3)	Sets F1capacitor in RF Module active. 1=ON
MOD1	(S2-4)	Sets modulation adjust (MOD1) active. 1=ON
MOD2	(S2-5)	Sets modulation adjust (MOD2) active. 1=ON
MOD3	(S2-6)	Sets modulation adjust (MOD3) active. 1=ON
N/A	(S2-7)	not used
64 MHz	(S2-8)	Sets 64 MHz bit on for frequency selection. 1=ON
4 MHz	(S3)	Sets 4 MHz step. HEX switch functions as follows: 0=0 MHz, 1=4MHz, 2=8 MHZ, …, E=56 MHz, F=60 MHz
250 kHz	(S4)	Sets 250 kHz step. HEX switch functions as follows: 0=0 kHz, 1=250 kHz, 2=500 kHZ, …, E=3.5 MHz, F=3.75 MHz
25 kHz	(S5)	Sets 25 kHz step. HEX switch functions as follows: 0=0 kHz, 1=25 kHz, 2=50 kHZ, …, E=350 kHz, F=375 kHz

5.5 Test Fixture Diagrams

The test fixtures shown in Figures 5-15 and 5-16 have been designed to interface with the equipment specified in Table 5-1.

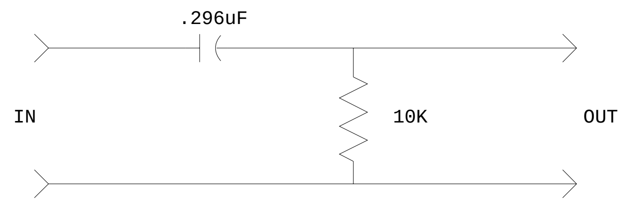


Figure 5-15
50 Hz High-Pass Filter

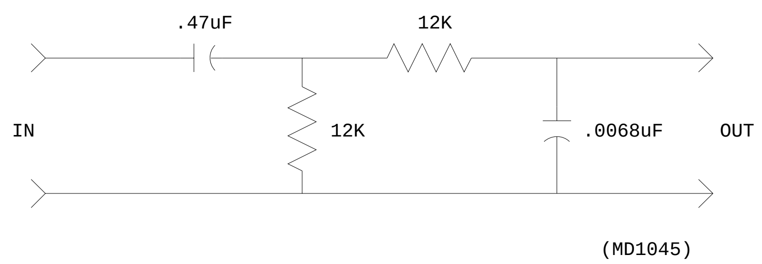


Figure 5-16
75 µs De-Emphasis with 30 Hz High-Pass Filter

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6 Customer Service

6.1 Introduction

Moseley Associates will assist its product users with difficulties. Most problems can be resolved through telephone consultation with our technical service department. When necessary, factory service may be provided. If you are not certain whether factory service of your equipment is covered, please check your product Warranty/Service Agreement.

Do not return any equipment to Moseley without prior consultation.

The solutions to many technical problems can be found in our product manuals; please read them and become familiar with your equipment.

We invite you to visit our Internet web site at **http://www.moseleysb.com/** .

6.2 Technical Consultation

Please have the following information available prior to calling the factory:

- Model number and serial number of unit;
- Shipment date or date of purchase of an Extended Service Agreement;
- Any markings on suspected subassemblies (such as revision level); and
- Factory test data, if applicable.

Efficient resolution of your problem will be facilitated by an accurate description of the problem and its precise symptoms. For example, is the problem intermittent or constant? What are the front panel indications? If applicable, what is your operating frequency?

Technical consultation is available at **(805) 968-9621** from 8:00 a.m. to 5:00 p.m., Pacific time, Monday through Friday. During these hours a technical service representative who knows your product should be available. If the representative for your product is busy, your call will be returned as soon as possible. Leave your name, station call letters if applicable, type of equipment, and telephone number(s) where you can be reached in the next few hours.

Please understand that, in trying to keep our service lines open, we may be unable to provide “walk-through” consultation. Instead, our representative will usually suggest the steps to resolve your problem; try these steps and, if your problem remains, do not hesitate to call back.

After-Hours Emergencies

Emergency consultation is available at 805.252.2133 from 5:00 p.m. to 10:00 p.m. Pacific time, Monday to Friday, and from 8:00 a.m. to 10:00 p.m. Pacific time on weekends and holidays. Please do not call during these hours unless you have an emergency with installed equipment. Our representative will not be able to take orders for parts, provide order status information, or assist with installation problems.

6.3 Factory Service

Arrangements for factory service should be made only with a Moseley technical service representative. You will be given a **Return Authorization (RA) number**. This number will expedite the routing of your equipment directly to the service department. Do not send any equipment to Moseley Associates without an RA number.

When returning equipment for troubleshooting and repair, include a detailed description of the symptoms experienced in the field, as well as any other information that well help us fix the problem and get the equipment back to you as fast as possible. Include your RA number inside the carton.

If you are shipping a complete chassis, all modules should be tied down or secured as they were originally received. On some Moseley Associates equipment, printing on the underside or topside of the chassis will indicate where shipping screws should be installed and secured.

Ship equipment in its original packing, if possible. If you are shipping a subassembly, please pack it generously to survive shipping. Make sure the carton is packed fully and evenly without voids, to prevent shifting. Seal it with appropriate shipping tape or nylon-reinforced tape. Mark the outside of the carton “Electronic Equipment - Fragile” in large red letters. Note the RA number clearly on the carton or on the shipping label, and make sure the name of your company is listed on the shipping label. Insure your shipment appropriately. All equipment must be shipped prepaid.

The survival of your equipment depends on the care you take in shipping it.

Address shipments to:

MOSELEY ASSOCIATES, INC.

Attn: Technical Services Department
82 Coromar Drive
Santa Barbara, CA 93117

Moseley Associates, Inc. will return the equipment prepaid under Warranty and Service Agreement conditions, and either freight collect or billed for equipment not covered by Warranty or a Service Agreement.

6.4 Field Repair

Some Moseley Associates equipment will have stickers covering certain potentiometers, varicaps, screws, and so forth. Please contact Moseley Associates technical service department before breaking these stickers. Breaking a tamperproof sticker may void your warranty.

When working with Moseley’s electronic circuits, work on a grounded antistatic surface, wear a ground strap, and use industry-standard ESD control.

Try to isolate a problem to a module or to a specific section of a module. Then compare actual wave shapes and voltage levels in your circuit with any shown on the block and level diagrams or schematics. These will sometimes allow the problem to be traced to a component.

Spare Parts Kits

Spare parts kits are available for all Moseley Associates products. We encourage the purchase of the appropriate kits to allow self-sufficiency with regard to parts. Information about spares kits for your product may be obtained from our sales department or technical service department.

Module Exchange

When it is impossible or impractical to trace a problem to the component level, replacing an entire module or subassembly may be a more expedient way to correct the problem. Replacement modules are normally available at Moseley Associates for immediate shipment. Arrange delivery of a module with our technical services representative. If the shipment is to be held at your local airport with a telephone number to call, please provide an alternate number as well. This can prevent unnecessary delays.

Field Repair Techniques

If an integrated circuit is suspect, carefully remove the original and install the new one, observing polarity. Installing an IC backward may damage not only the component itself, but the surrounding circuitry as well. IC's occasionally exhibit temperature-sensitive characteristics. If a device operates intermittently, or appears to drift, rapidly cooling the component with a cryogenic spray may aid in identifying the problem.

If a soldered component must be replaced, do the following:

- Use a 40W maximum soldering iron with an 1/8-inch maximum tip. Do not use a soldering gun. Excessive heat can damage components and the printed circuit. Surface mount devices are especially heat sensitive, and require a lower power soldering iron. If you are not experienced with surface mount components, we suggest that you do not learn on critical equipment.
- Remove the solder from the component leads and the printed circuit pads. Solder wicking braid or a vacuum de-solderer are useful for this. Gently loosen the component leads and extract the component from the board.
- Form the leads of the replacement component to fit easily into the circuit board pattern.
- Solder each lead of the component to the bottom side of the board, using a good brand of rosin-core solder. We recommend not using water soluble flux, particularly in RF portions of the circuit. The solder should flow through the hole and form a fillet on both sides. Fillets should be smooth and shiny, but do not overheat the component trying to obtain this result.
- Trim the leads of the replacement component close to the solder on the pad side of the printed circuit board with a pair of diagonal cutters.
- Completely remove all residual flux with a cotton swab moistened with flux cleaner.
- For long term quality, inspect each solder joint—top-side and bottom—under a magnifier and rework solder joints to meet industry standards. Inspect the nearby components soldered by the Moseley Associates production line for an example of high reliability soldering.

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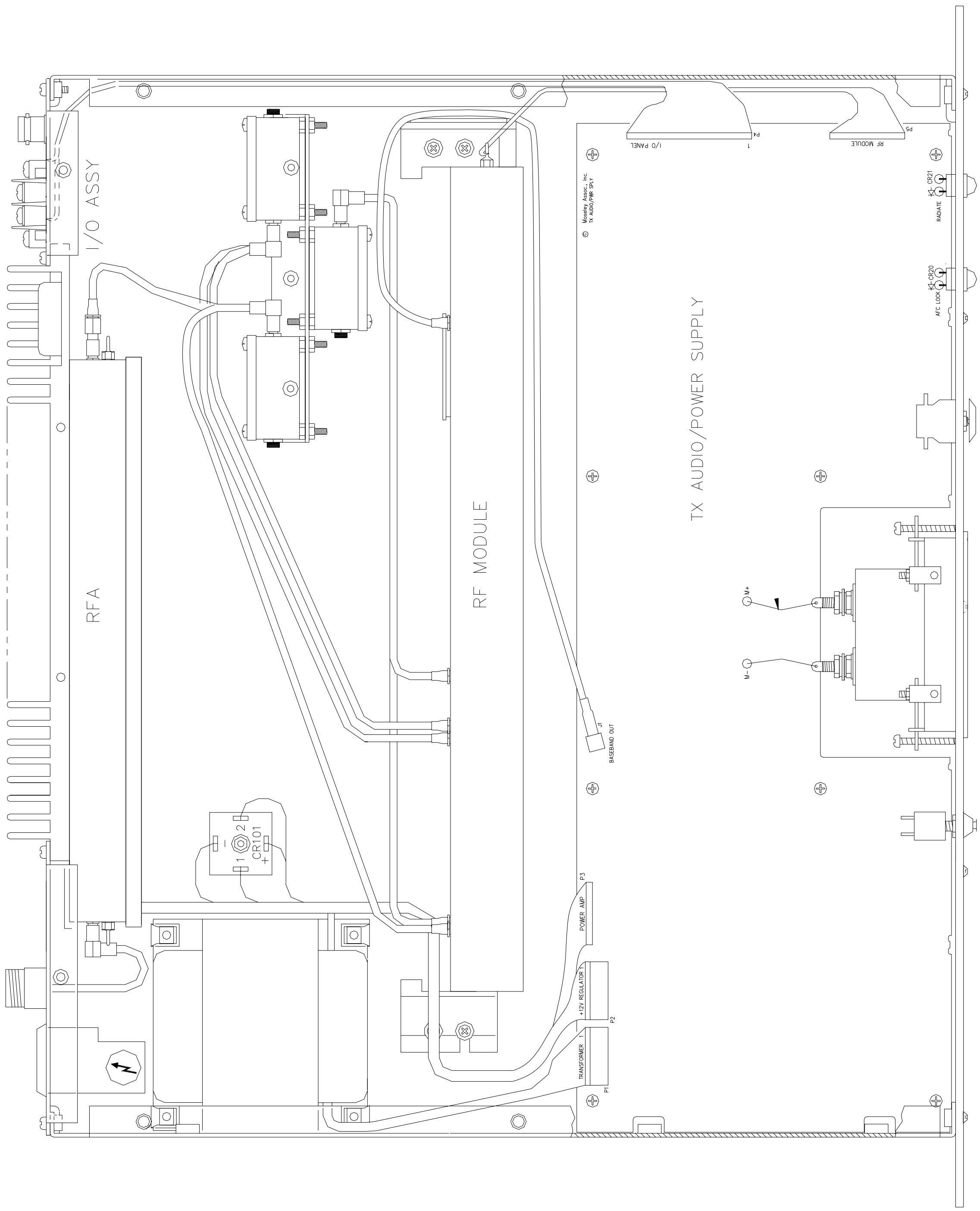
7 Schematics and Assembly Drawings

7.1 PCL 6000-220 STD (602-10300-71 Rev A)

DESCRIPTION	ENG. DWG. No.	REV LEVEL	REV DATE
Transmitter Final Assembly	21B2890	C	08-95
Transmitter Audio/Power Supply Schematic	91B7444	D	08-95
Transmitter Audio/Power Supply Assembly	20B3023	D	08-95
Transmitter RF Module Schematic	600-10227-01	H	08-95
Transmitter RF Module Assembly	930-03462-01	H	08-95
RF Amplifier Schematic	91A7456	B	08-95
RF Amplifier Assembly	20B3037	B	08-95
6020 Receiver Final Assembly	21B2891-3	D	08-95
6030 Receiver Final Assembly	21B2892-3	D	08-95
Receiver Audio/Power Supply Schematic	600-10710-01	B	08-95
Receiver Audio/Power Supply Assembly	20B3024	C	08-95
Receiver RF Module Schematic	600-10228-01	K	08-95
Receiver RF Module (6030) Assembly	930-03595-01	J	08-95
IF Demod (6020) Schematic	91B7375	C	08-95
IF Demod (6020) Assembly	20B2941-2	C	08-95
Double Converter(6030) Schematic	91B7451	E	08-95
Double Converter(6030) Assembly	20B3039	E	08-95
FM Demod (6030) Schematic	91B7387	F	08-95
FM Demod (6030) Assembly	20B2949	G	08-95

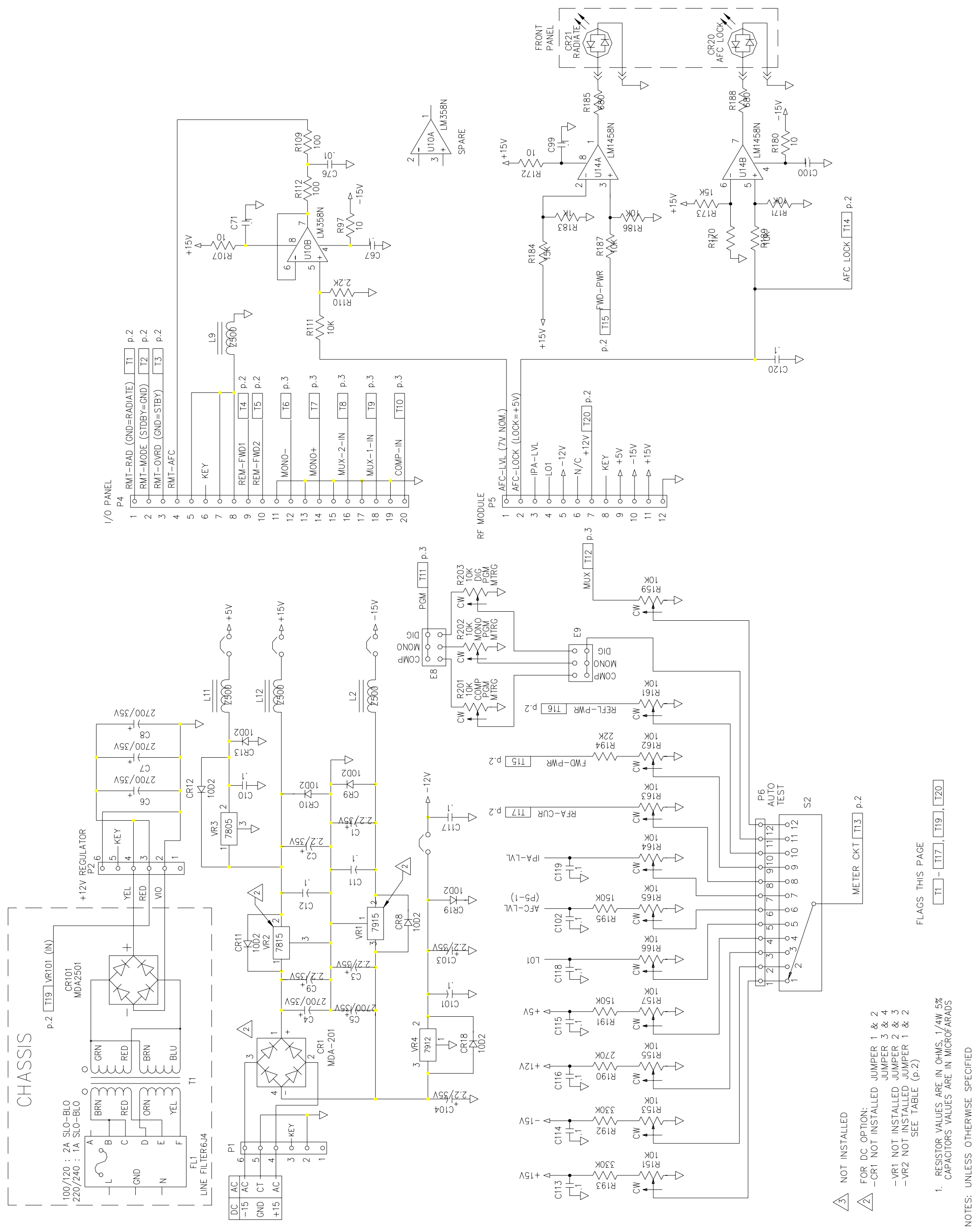
NOTICE:

This section contains schematic and assembly drawings referred to in Sections 1 and 4. For information on individual drawings refer to Section 1 under "System Description" and/or Section 4 under "Module Description".



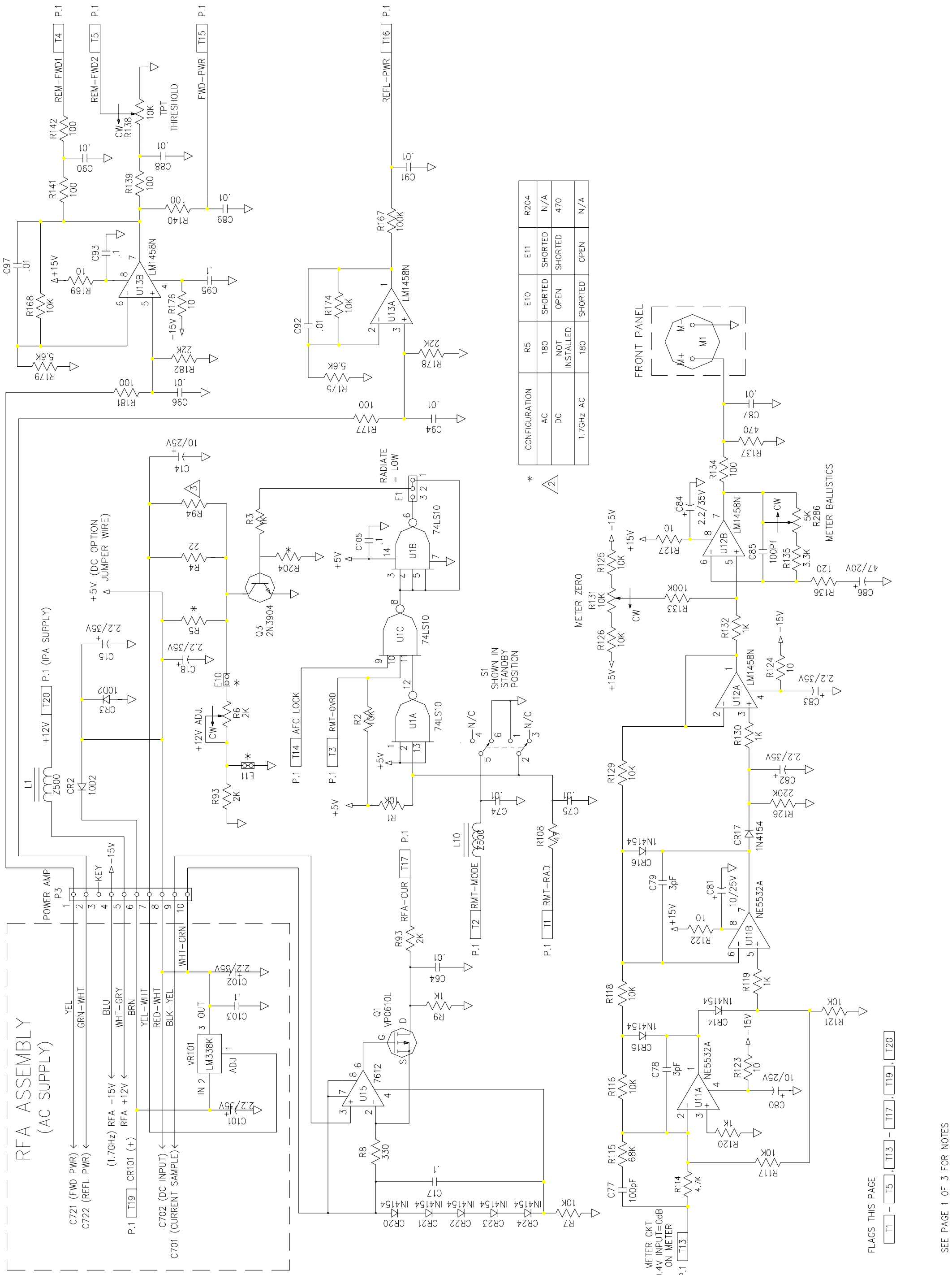
21B2890 Rev C

6010 Transmitter Final Assembly (220 MHz)



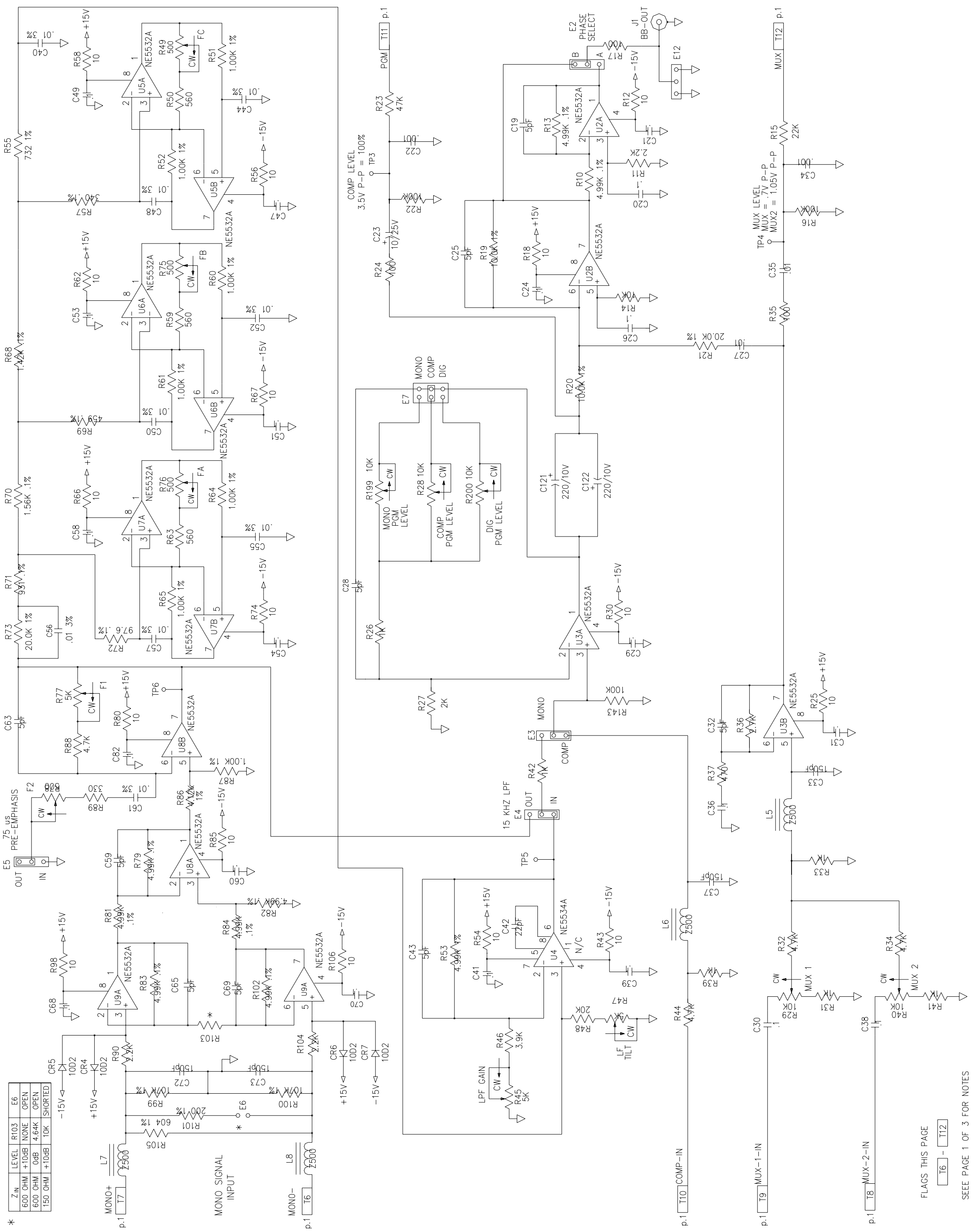
91A7444 Rev D

Transmitter Audio/Power Supply Schematic, p. 1 of 3



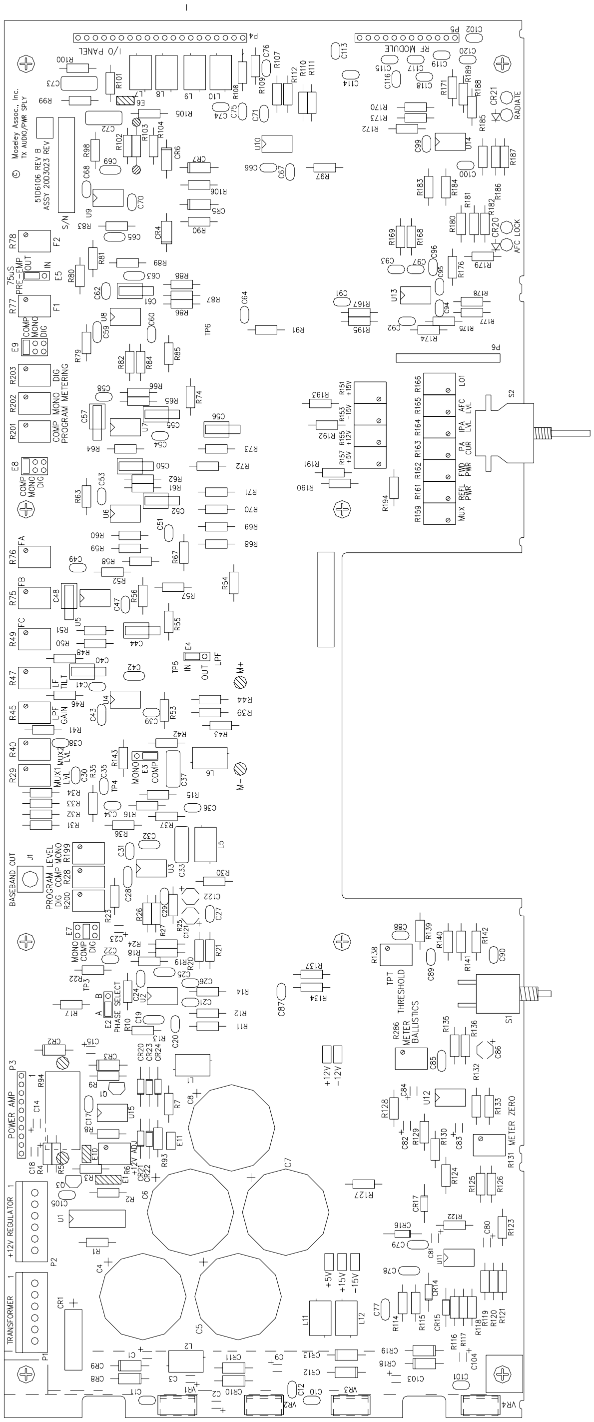
91A7444 Rev D

Transmitter Audio/Power Supply Schematic, p. 2 of 3



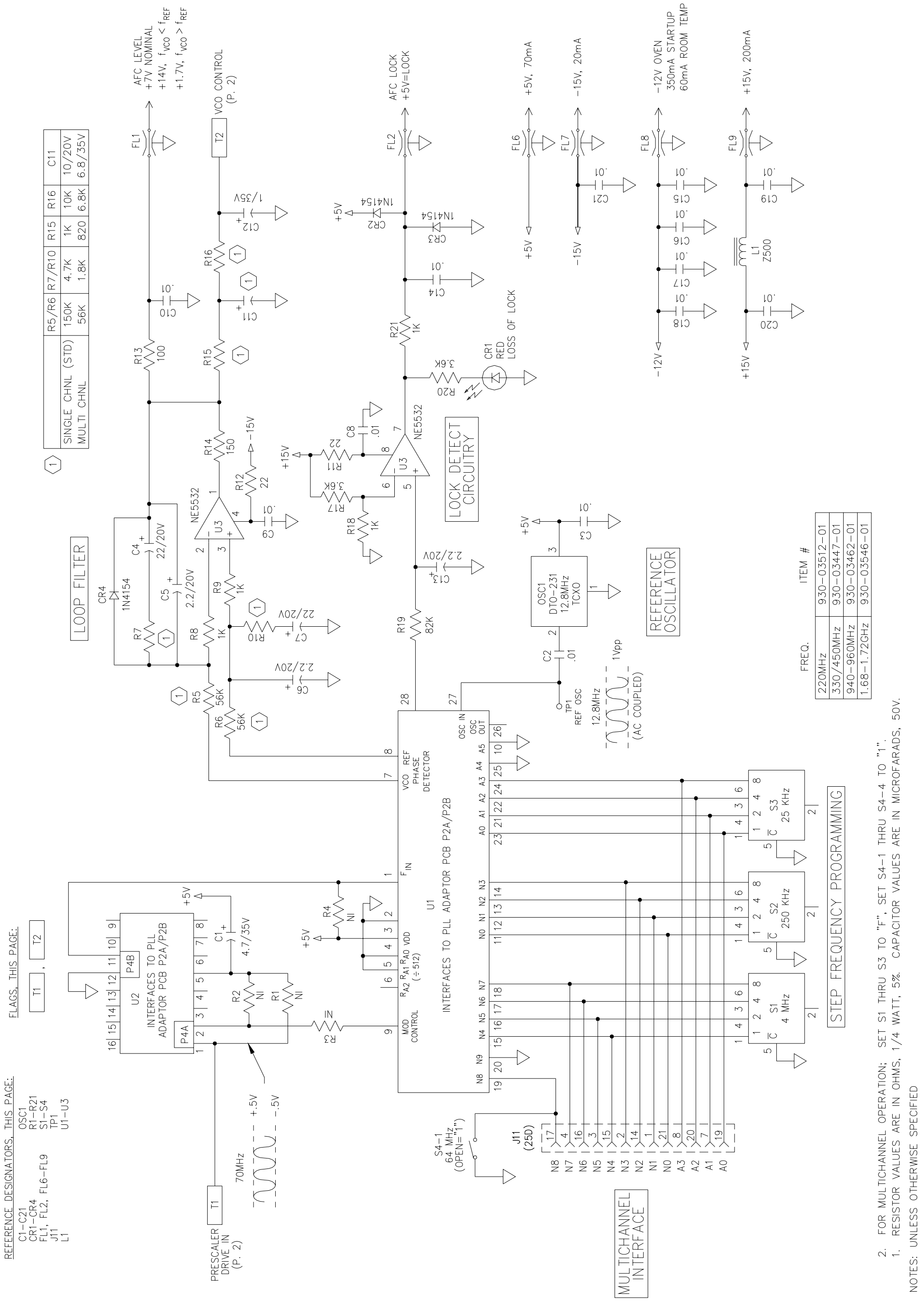
91A7444 Rev D

Transmitter Audio/Power Supply Schematic, p. 3 of 3



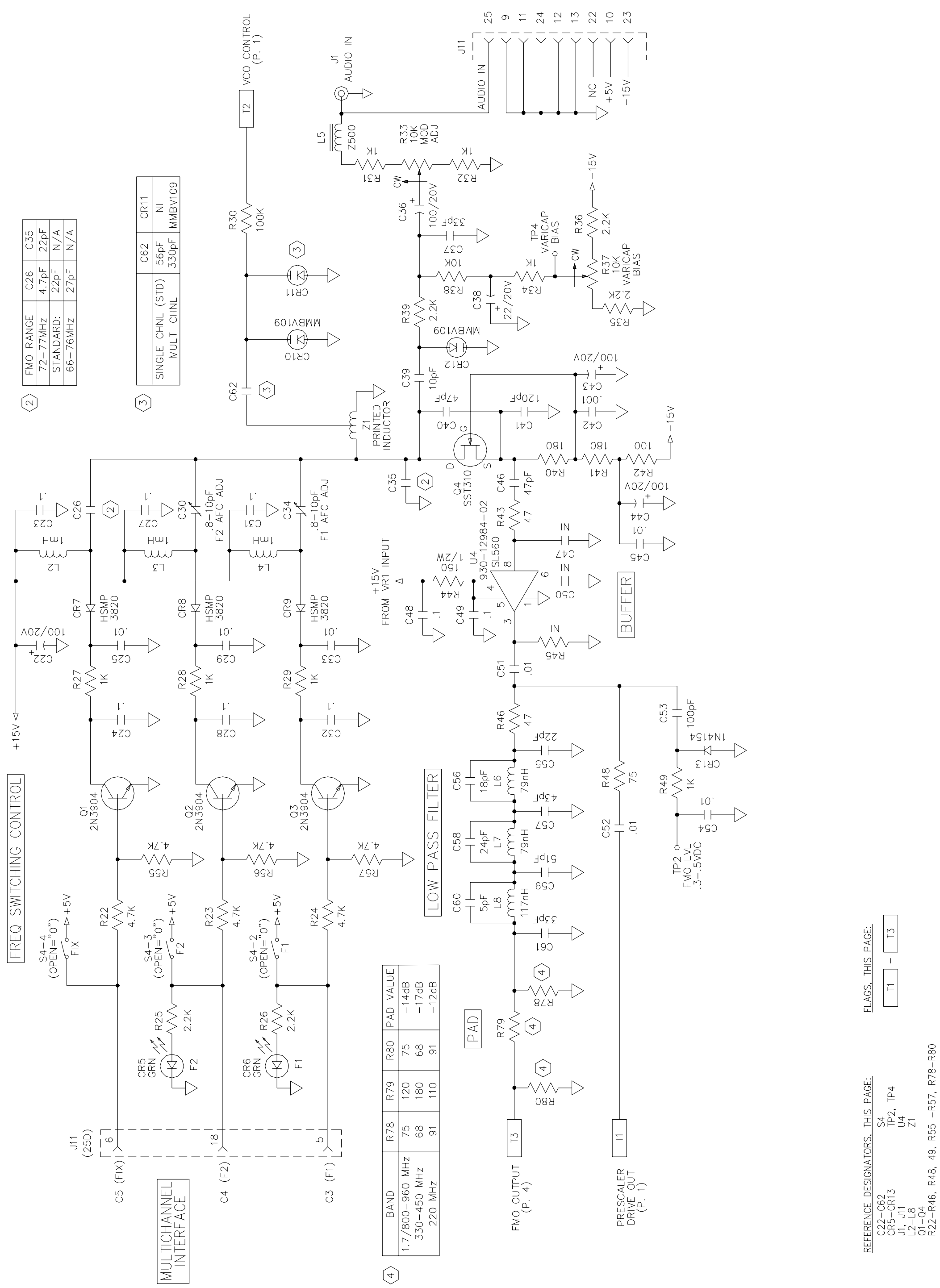
20D3023 Rev D

Transmitter Audio/Power Supply Assembly



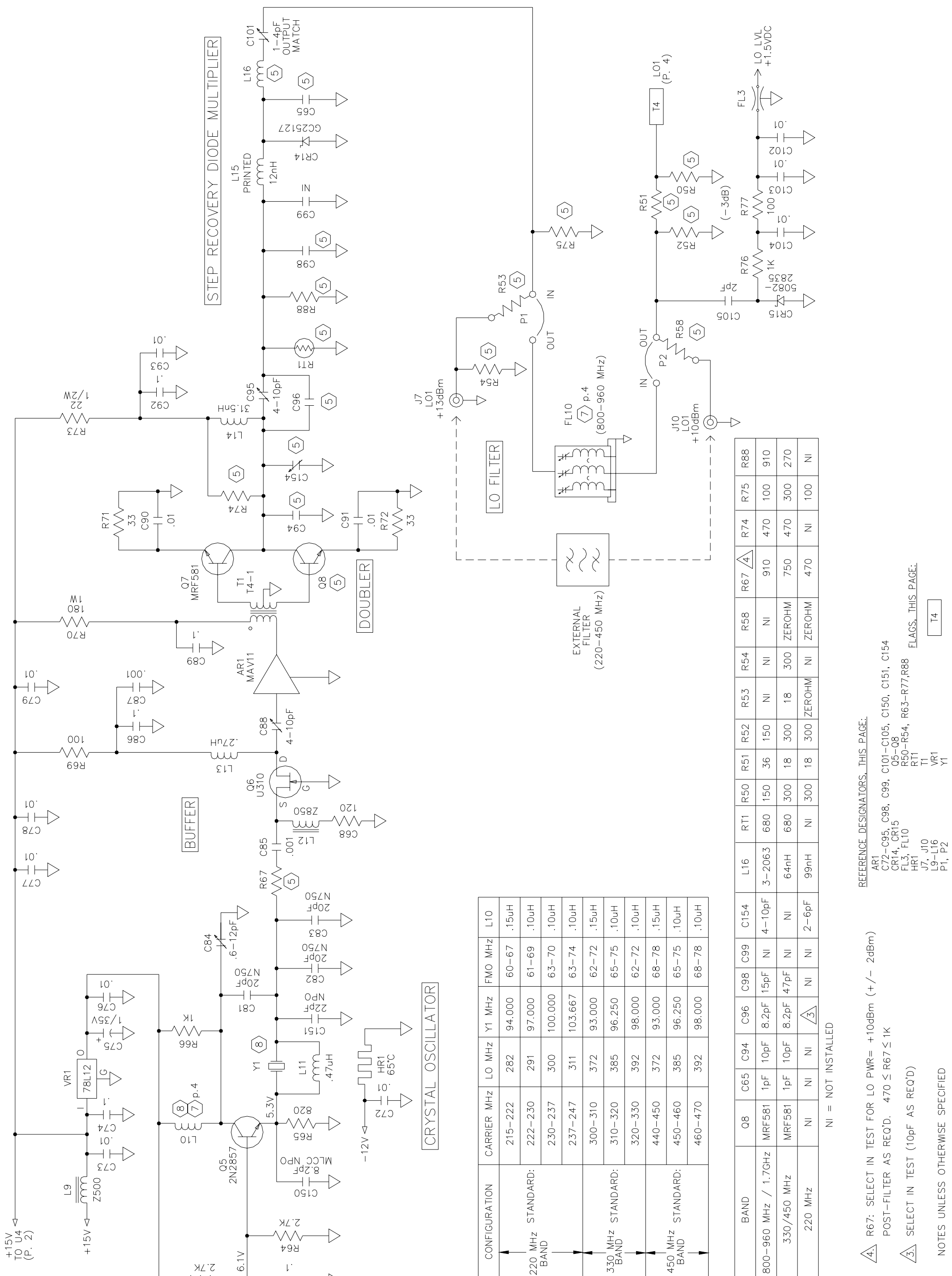
600-10227-01 REV H

Transmitter RF Module Schematic, p. 1 of 4



600-10227-01 REV H

Transmitter RF Module Schematic, p. 2 of 4



8 CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz	FMO MHz	L10
220 MHz BAND	STANDARD:	215–222	282	94.000	60–67	.15uH
		222–230	291	97.000	61–69	.10uH
		230–237	300	100.000	63–70	.10uH
		237–247	311	103.667	63–74	.10uH
330 MHz BAND	STANDARD:	300–310	372	93.000	62–72	.15uH
		310–320	385	96.250	65–75	.10uH
		320–330	392	98.000	62–72	.10uH
450 MHz BAND	STANDARD:	440–450	372	93.000	68–78	.15uH
		450–460	385	96.250	65–75	.10uH
		460–470	392	98.000	68–78	.10uH

5 BAND	Q8	C65	C94	C96	C98	C99	C154	L16	RT1	R50	R51	R52	R53	R54	R58	R67 4	R74	R75	R88
800–960 MHz / 1.7GHz	MRF581	1pF	10pF	8.2pF	15pF	NI	4–10pF	3–2063	680	150	36	150	NI	NI	NI	910	470	100	910
330/450 MHz	MRF581	1pF	10pF	8.2pF	47pF	NI	NI	64nH	680	300	18	300	18	300	ZEROHM	750	470	300	270
220 MHz	NI	NI	NI	3	NI	NI	2–6pF	99nH	NI	300	18	300	ZEROHM	NI	ZEROHM	470	NI	100	NI

NI = NOT INSTALLED

4. R67: SELECT IN TEST FOR LO PWR= +10dBm (+/− 2dBm) POST-FILTER AS REQ'D. 470 ≤ R67 ≤ 1K

3. SELECT IN TEST (10pF AS REQ'D)

NOTES UNLESS OTHERWISE SPECIFIED

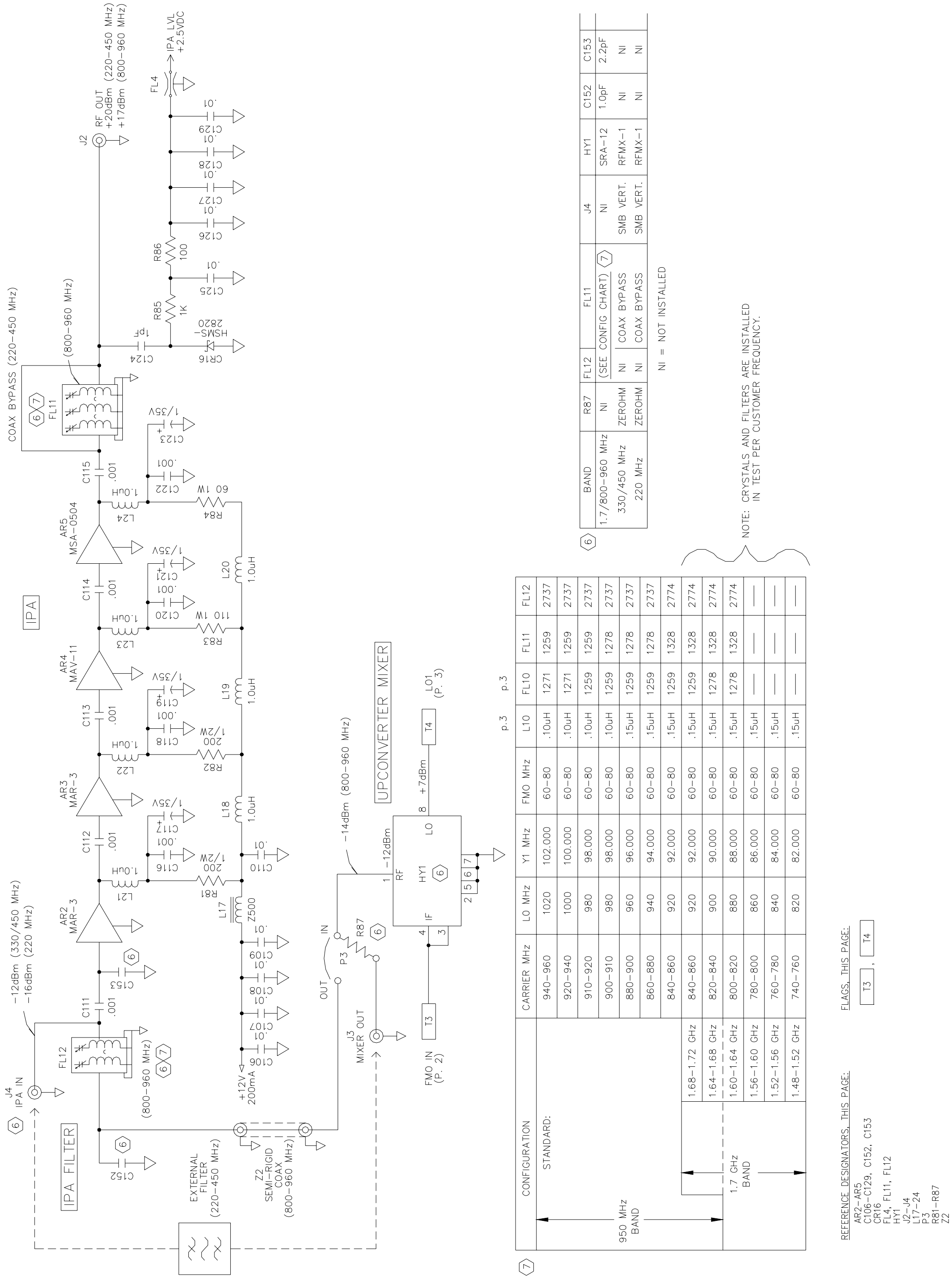
REFERENCE DESIGNATORS, THIS PAGE:

AR1	
C72–C95, C98, C99, C101–C105, C150, C151, C154	
CR14, CR15	Q5–Q8
FL3, FL10	R50–R54, R63–R77,R88
HR1	RT1
J7, J10	T1
L9–L16	VR1
P1, P2	Y1

FLAGS, THIS PAGE: T4

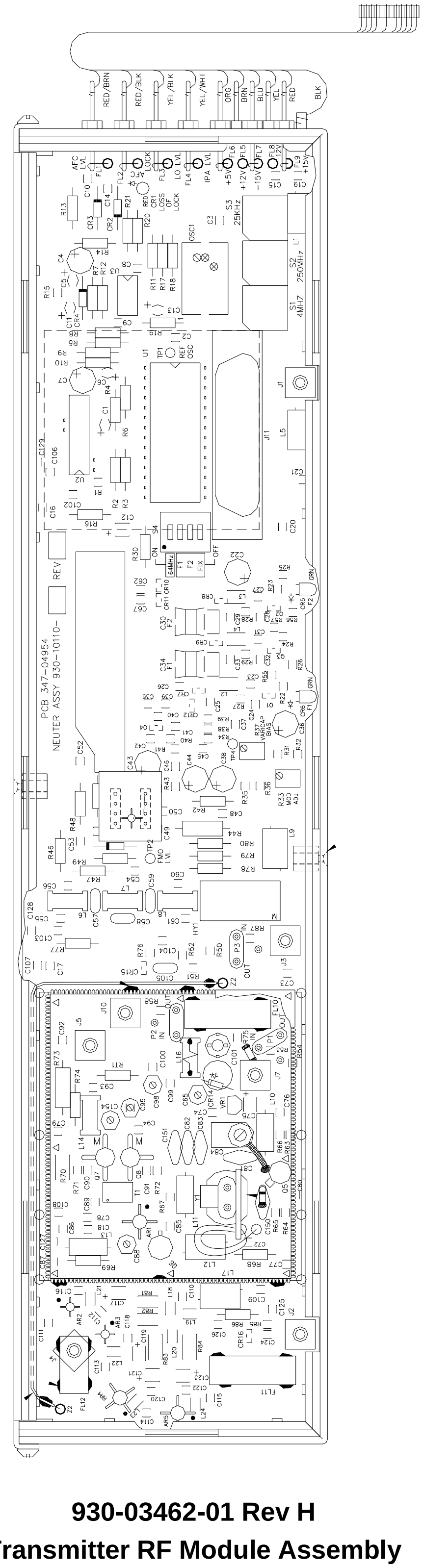
600-10227-01 REV H

Transmitter RF Module Schematic, p. 3 of 4



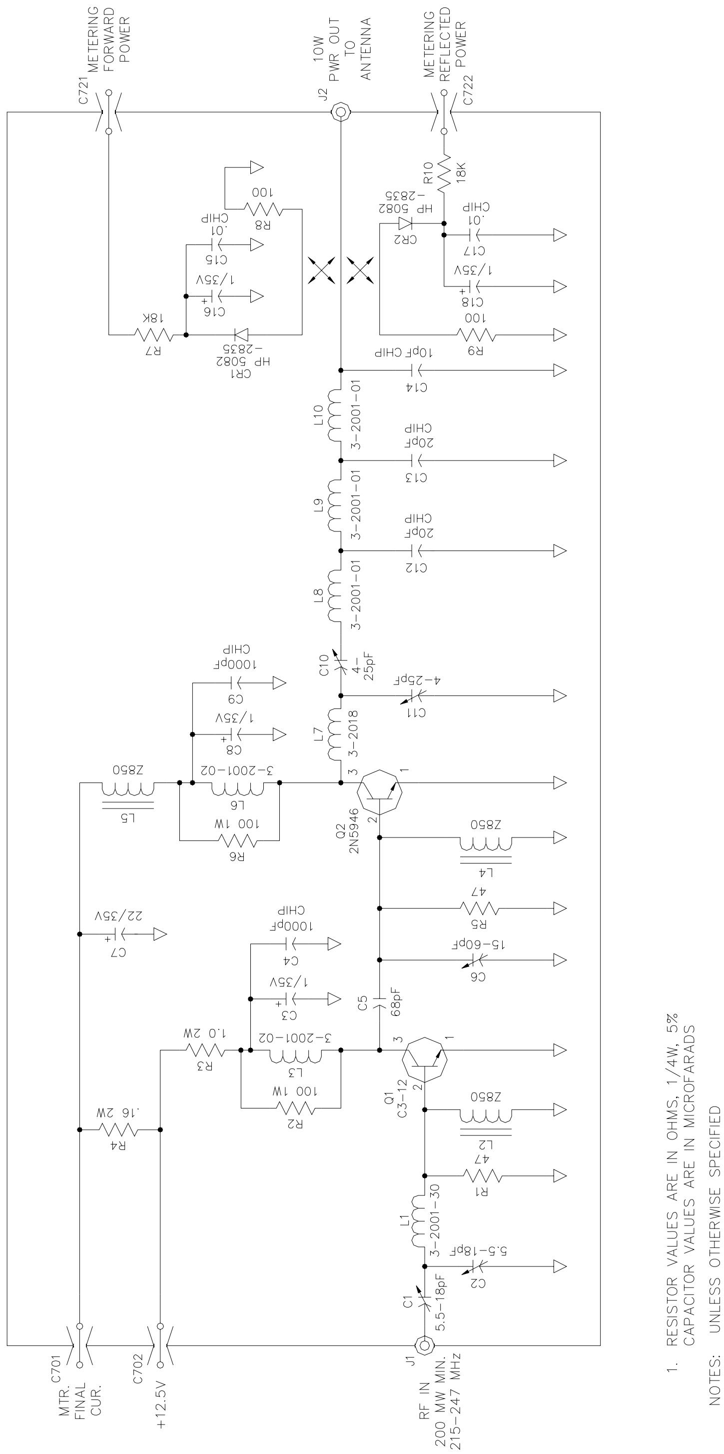
600-10227-01 REV H

Transmitter RF Module Schematic, p. 4 of 4

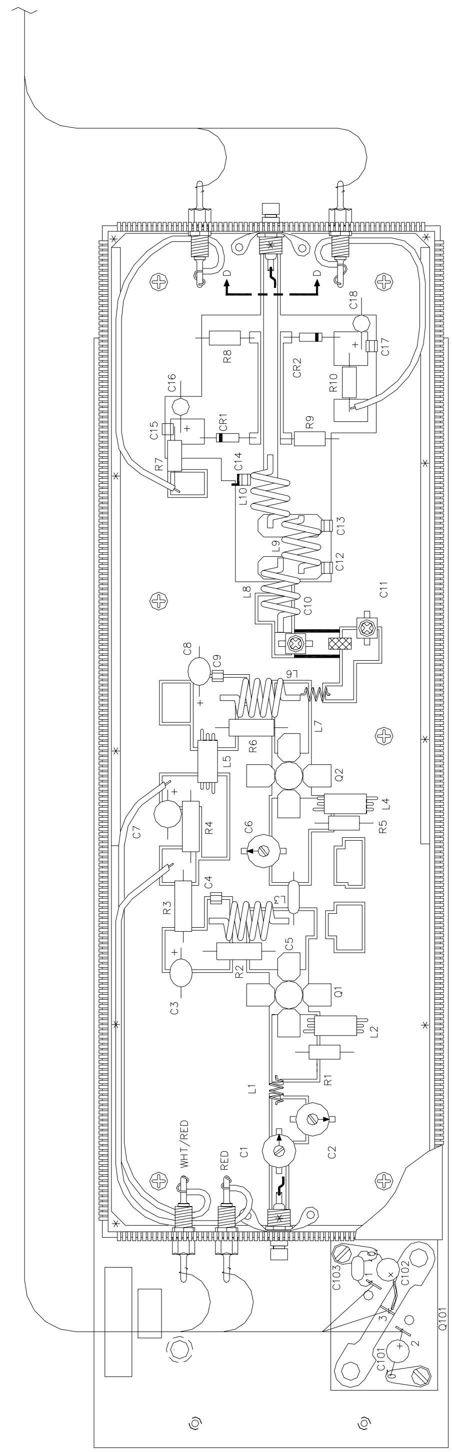


930-03462-01 Rev H

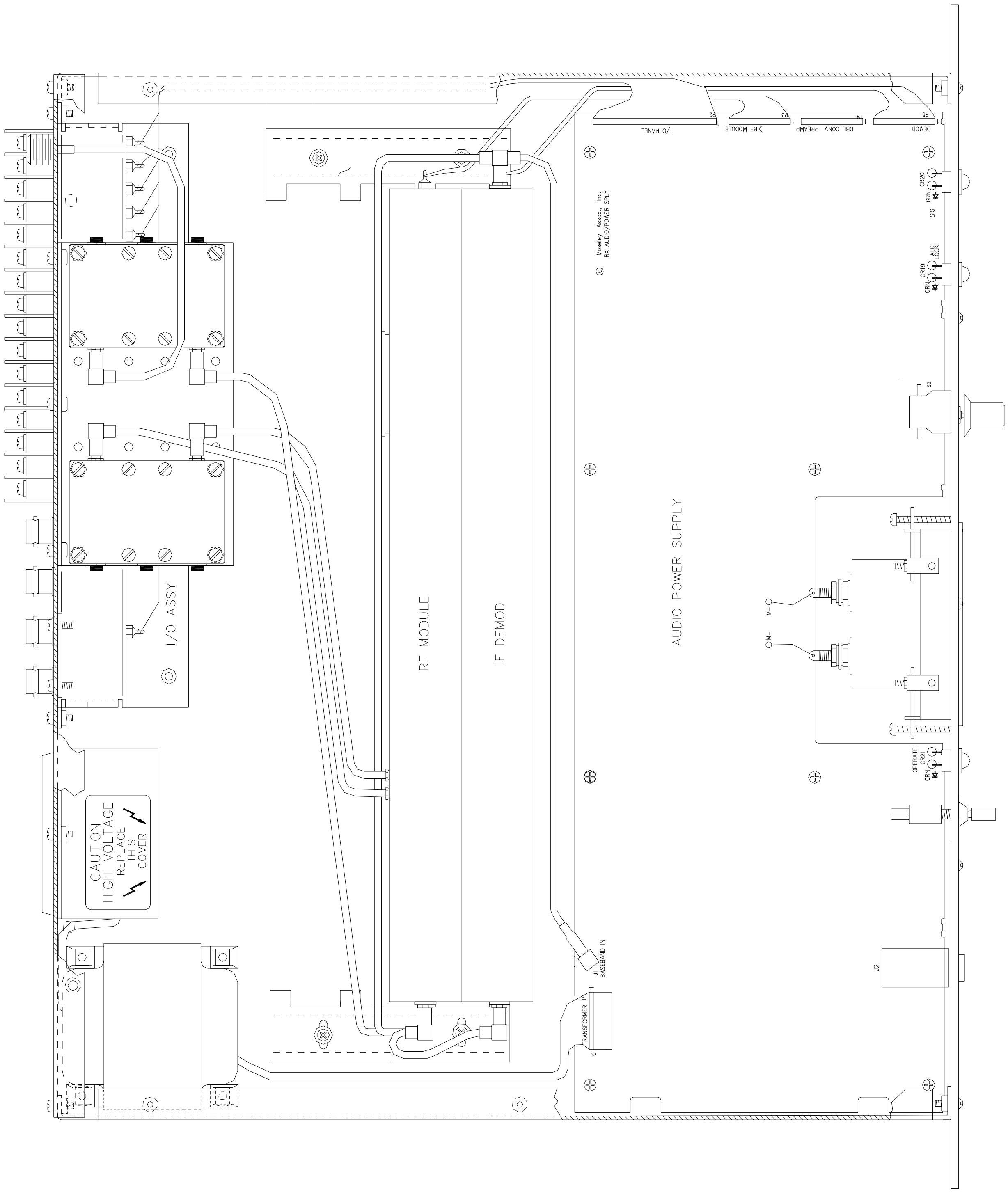
Transmitter RF Module Assembly



91A7456 Rev B
RF Amplifier (220 MHz) Schematic

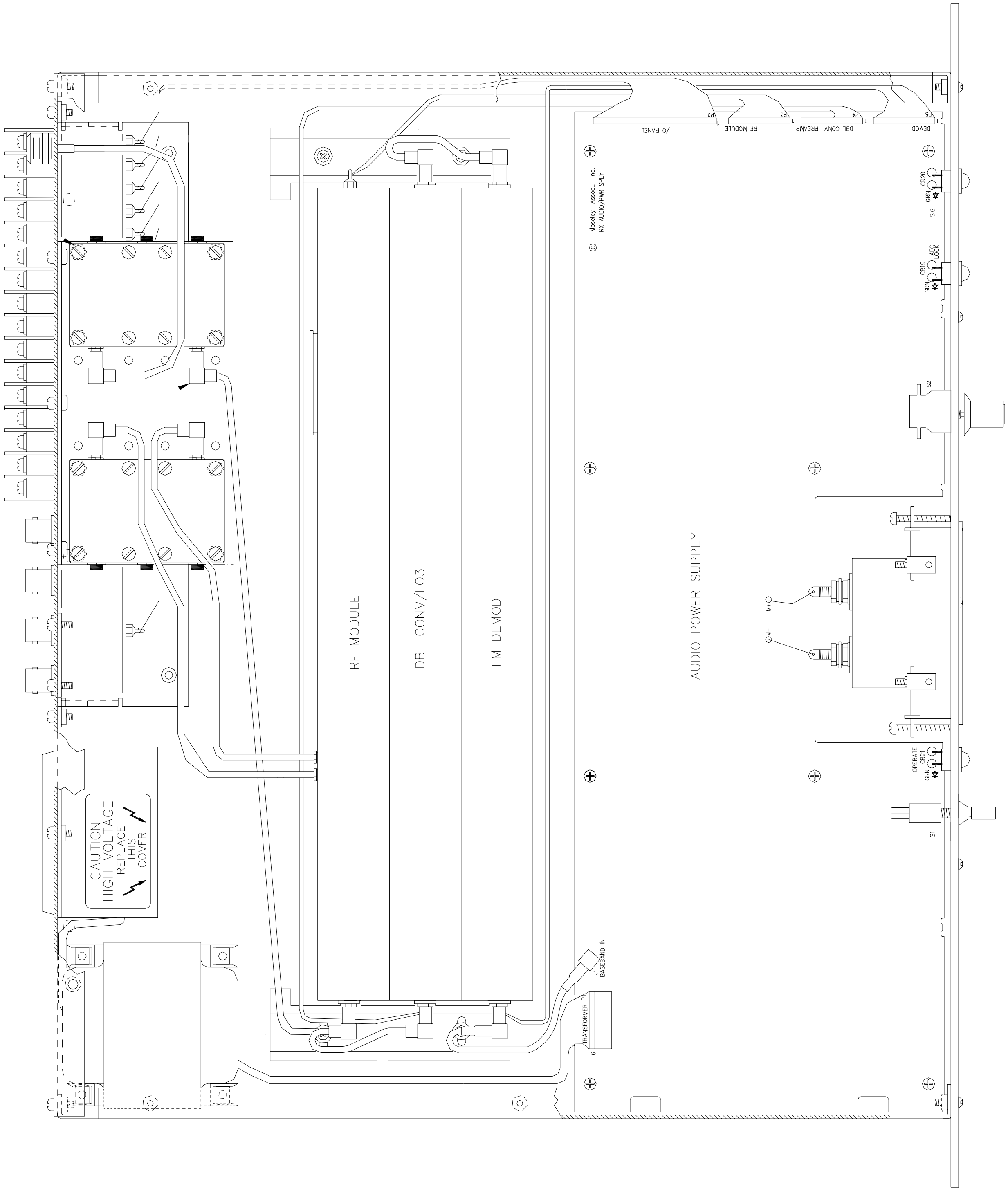


20B3037 Rev B
RF Amplifier (220 MHz) Assembly

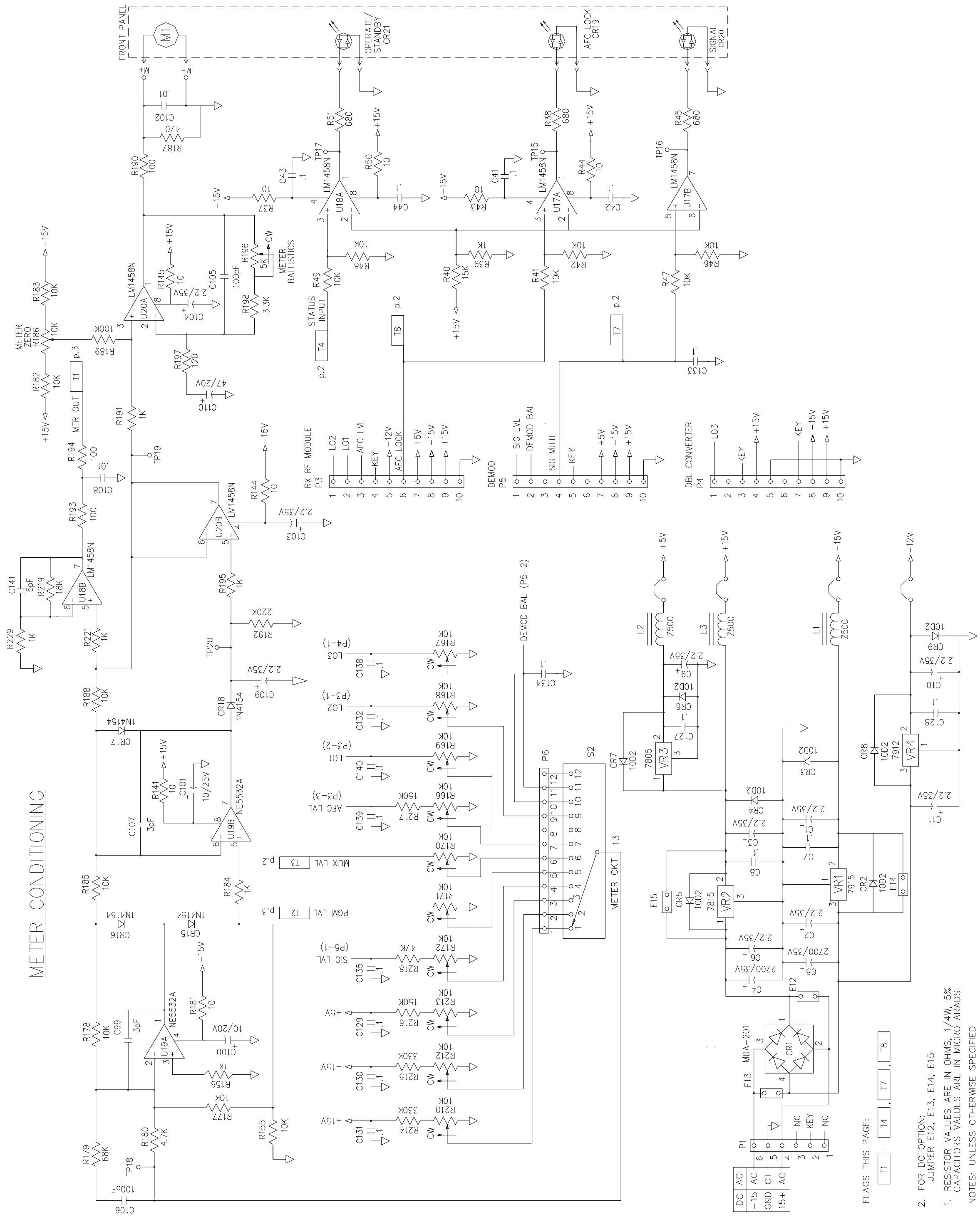


21B2891 Rev D

6020 Receiver Final Assembly

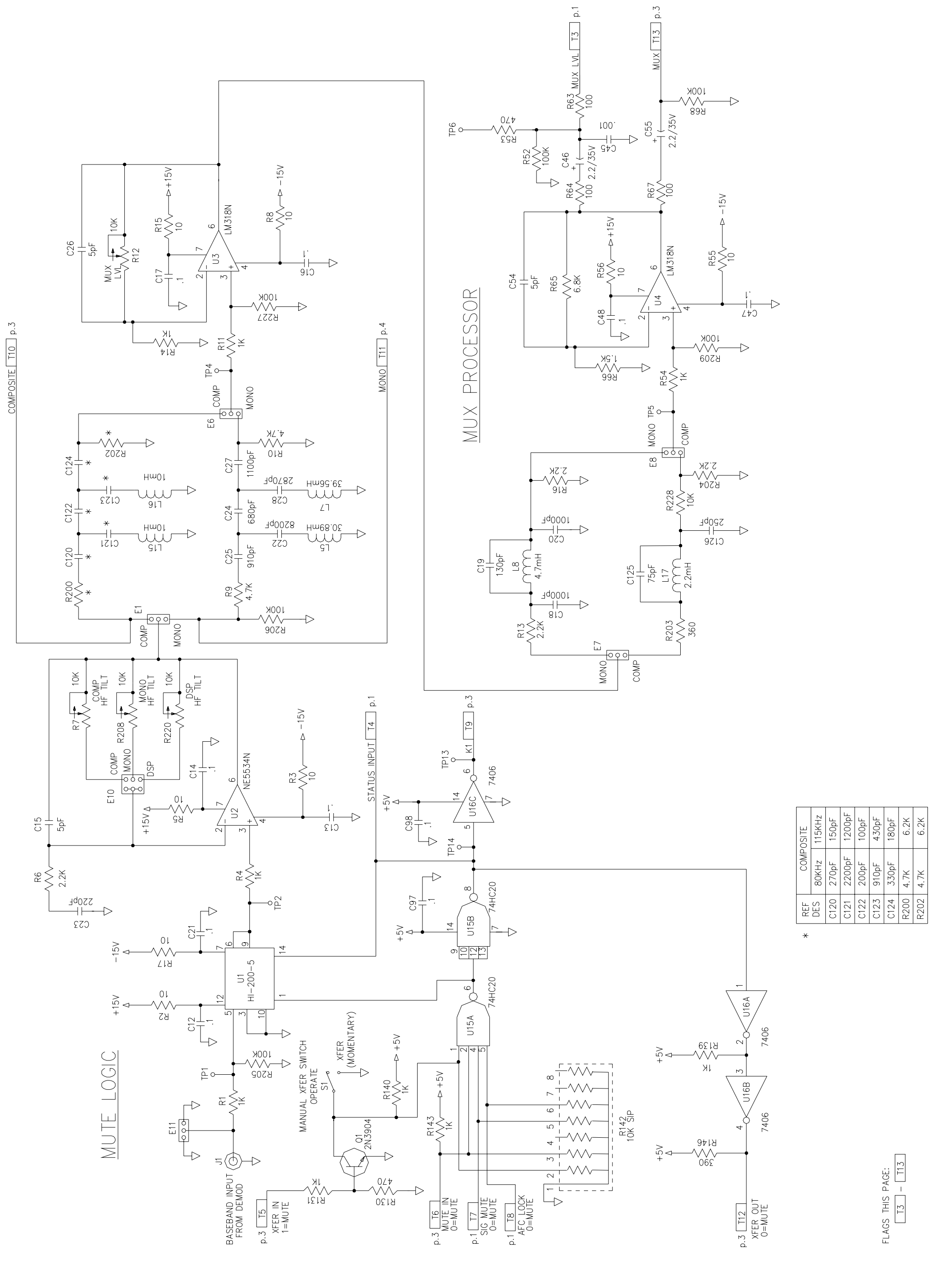


21B2892 Rev D
6030 Receiver Final Assembly



600-10710-01 Rev B

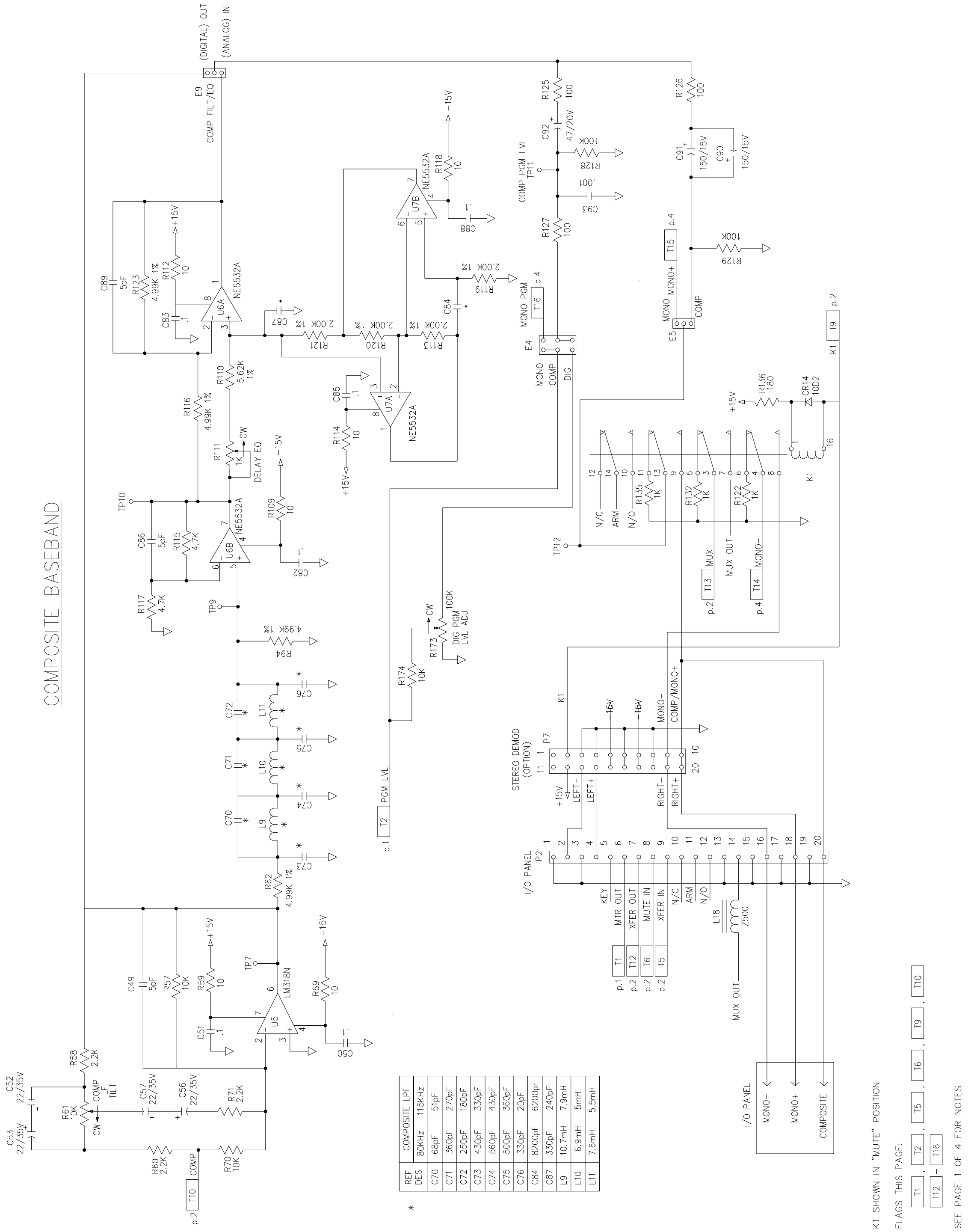
Receiver Audio/Power Supply Schematic, p. 1 of 4



* REF DES	COMPOSITE 80KHz	COMPOSITE 115KHz
C120	270pF	150pF
C121	2200pF	1200pF
C122	200pF	100pF
C123	910pF	430pF
C124	330pF	180pF
R200	4.7K	6.2K
R202	4.7K	6.2K

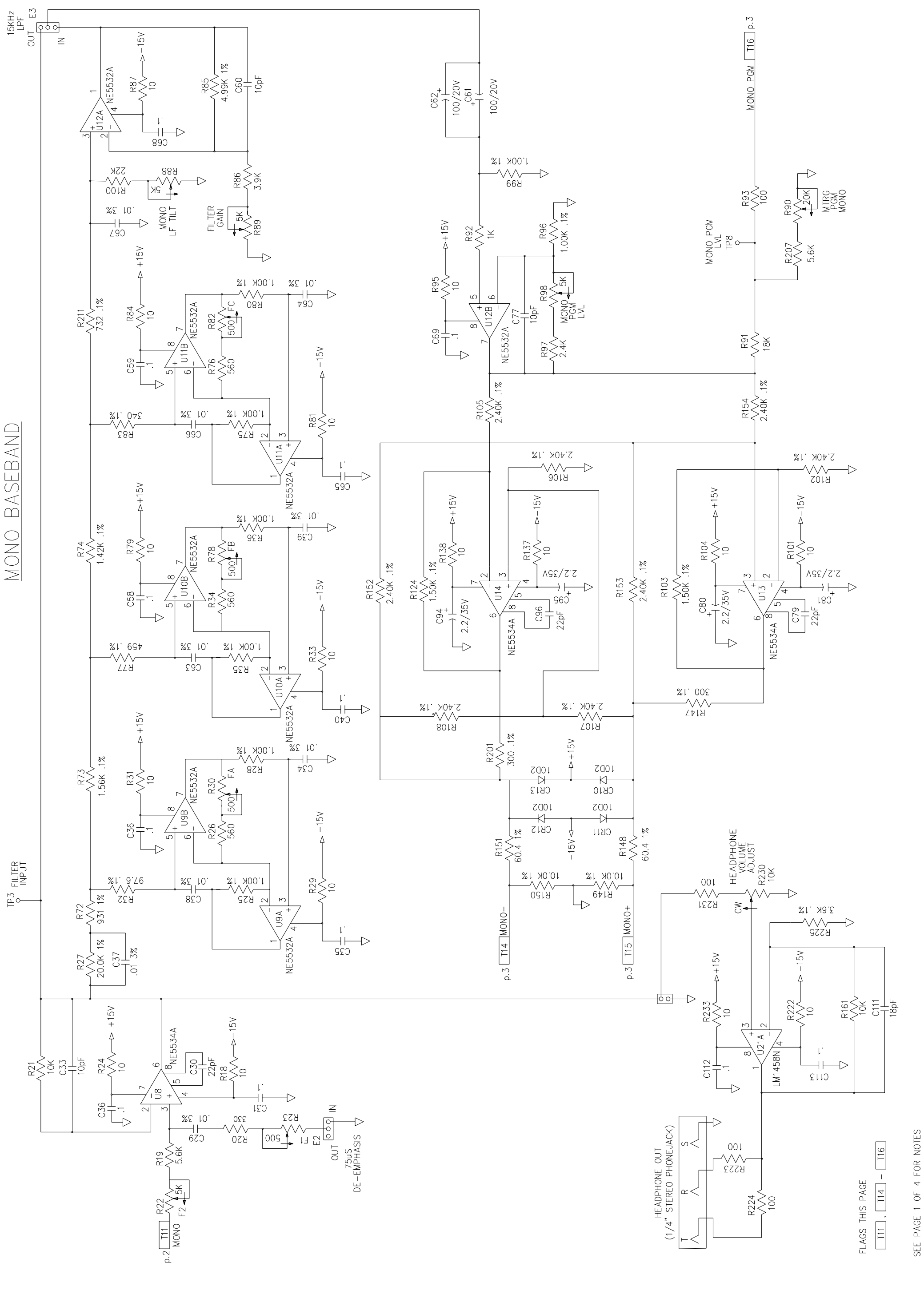
600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 2 of 4



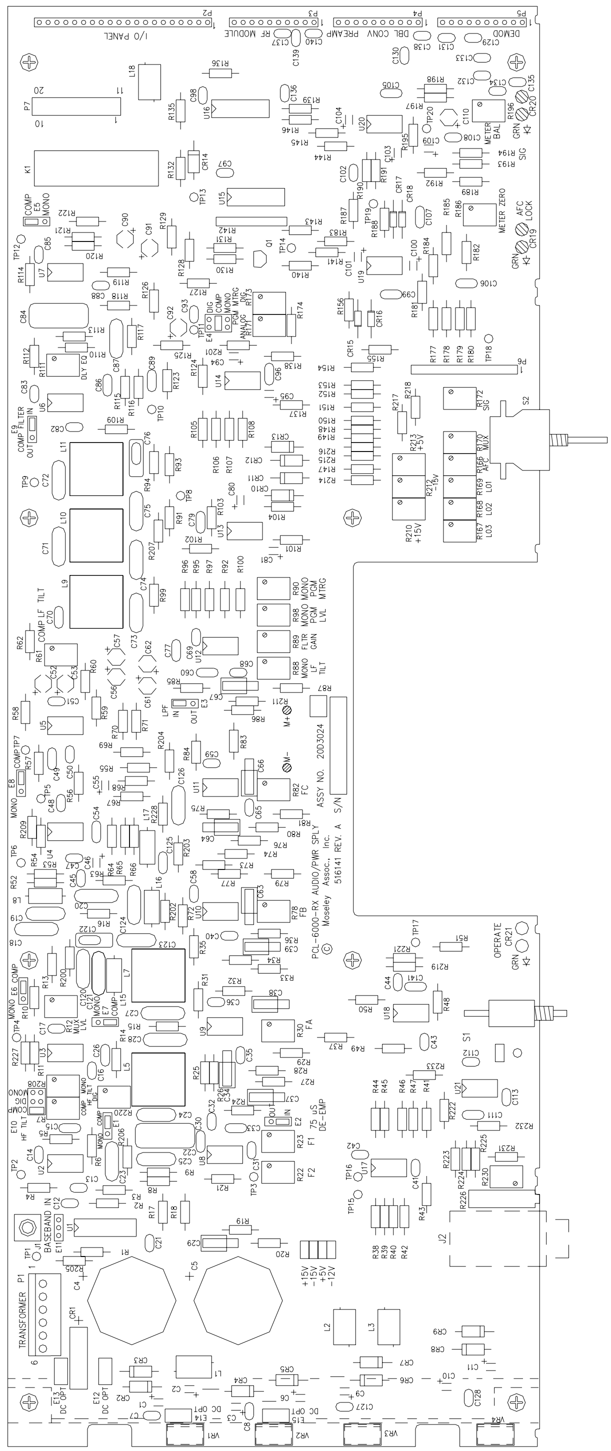
600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 3 of 4

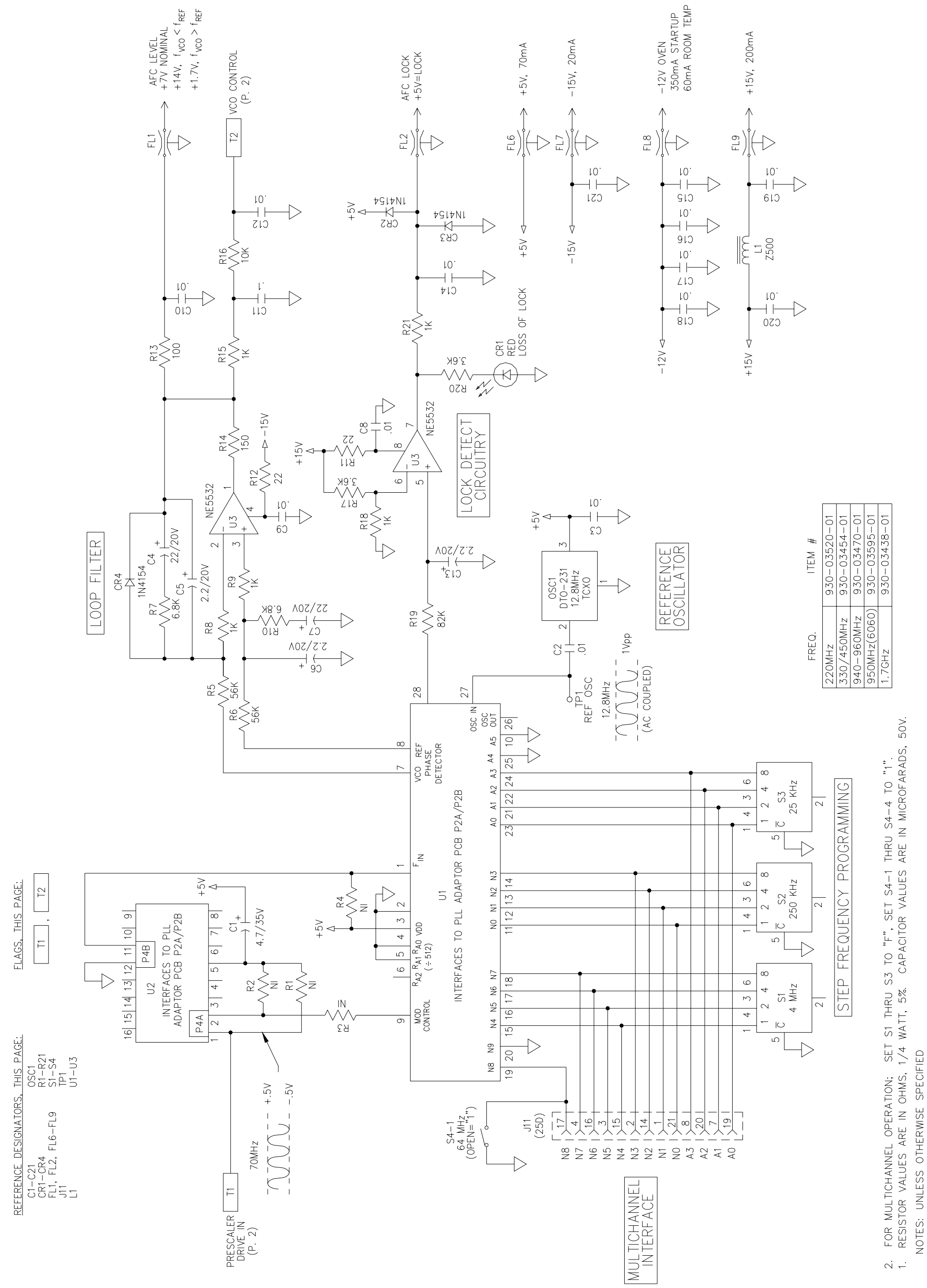


600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 4 of 4

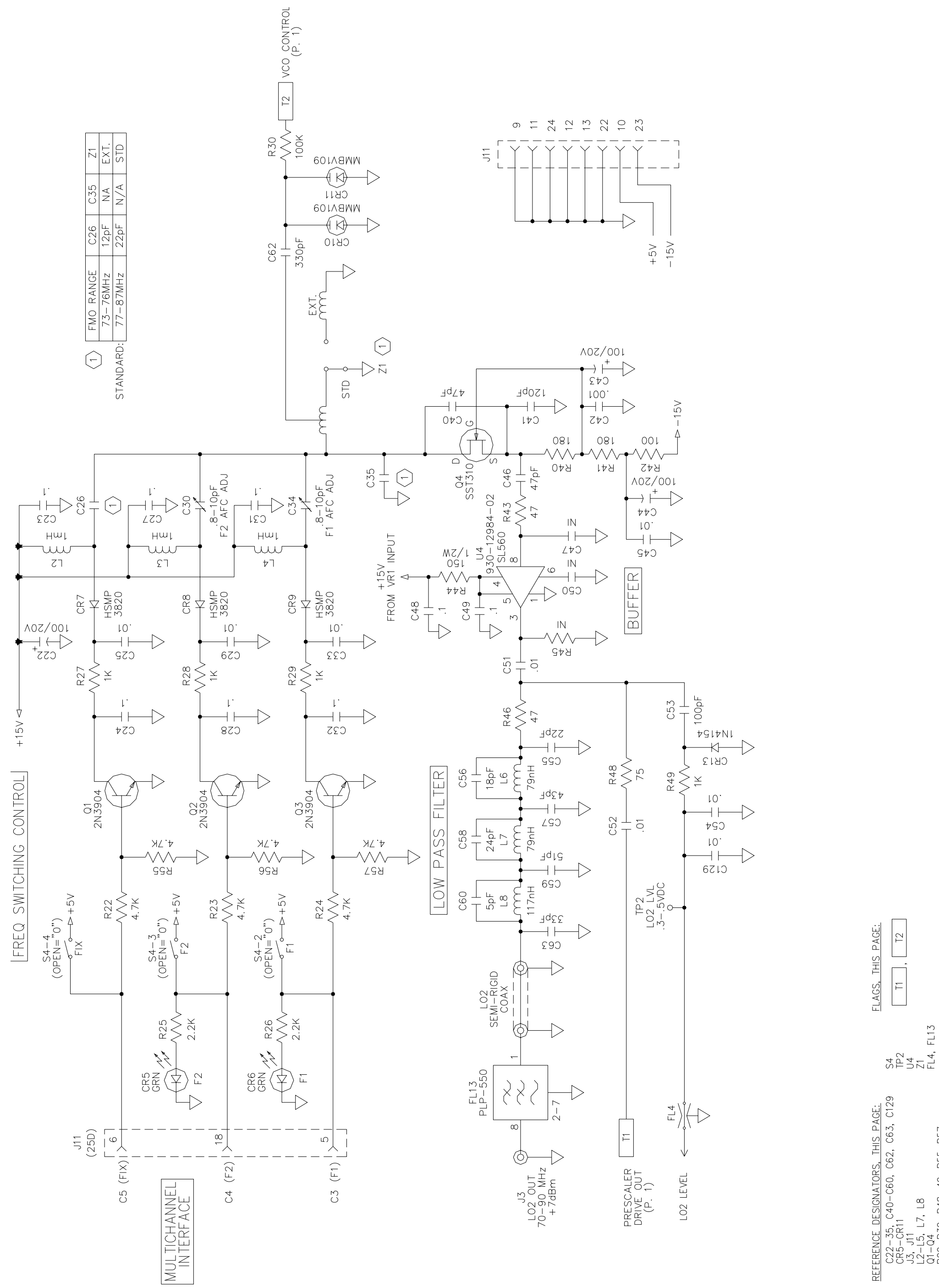


20B3024 Rev C
Receiver Audio/Power Supply Assembly

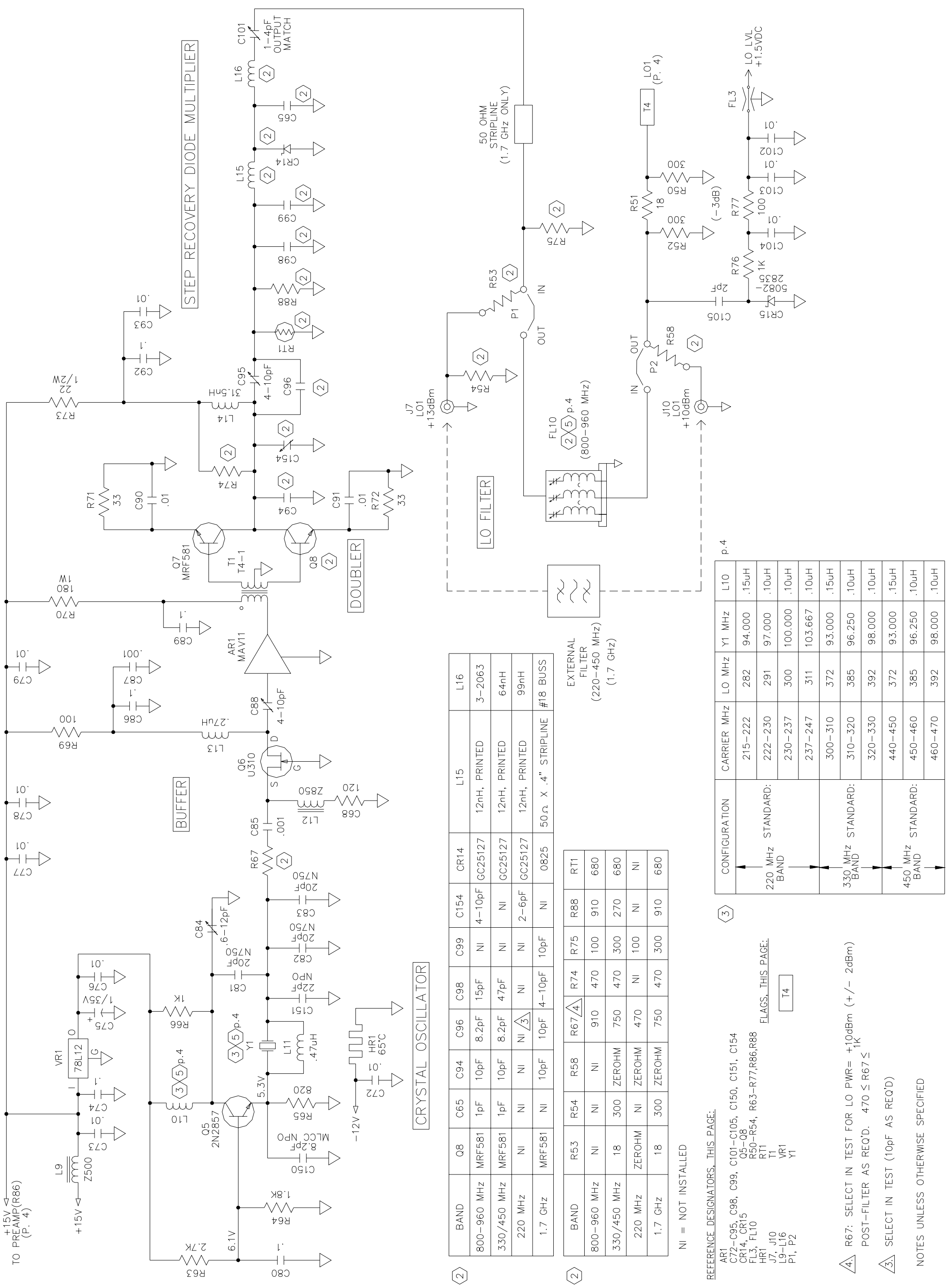


600-10228-01 Rev K

Receiver RF Module Schematic, p. 1 of 4



600-10228-01 Rev K
Receiver RF Module Schematic, p. 2 of 4



(2)

BAND	Q8	C65	C94	C96	C98	C99	C154	CR14	L15	L16
800-960 MHz	MRF581	1pF	10pF	8.2pF	15pF	NI	4-10pF	GC25127	12nH, PRINTED	3-2063
330/450 MHz	MRF581	1pF	10pF	8.2pF	47pF	NI	NI	GC25127	12nH, PRINTED	64nH
220 MHz	NI	NI	NI	NI (3)	NI	NI	2-6pF	GC25127	12nH, PRINTED	99nH
1.7 GHz	MRF581	NI	10pF	10pF	4-10pF	10pF	NI	0825	50Ω X .4" STRIPLINE	#18 BUSS

(2)

BAND	R53	R54	R58	R67 (4)	R74	R75	R88	RT1
800-960 MHz	NI	NI	NI	910	470	100	910	680
330/450 MHz	18	300	ZEROHM	750	470	300	270	680
220 MHz	ZEROHM	NI	ZEROHM	470	NI	100	NI	NI
1.7 GHz	18	300	ZEROHM	750	470	300	910	680

NI = NOT INSTALLED

(3)

CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz	L10 p.4
220 MHz BAND	STANDARD:	215-222	282	94.000	.15uH
		222-230	291	97.000	.10uH
		230-237	300	100.000	.10uH
		237-247	311	103.667	.10uH
330 MHz BAND	STANDARD:	300-310	372	93.000	.15uH
		310-320	385	96.250	.10uH
		320-330	392	98.000	.10uH
450 MHz BAND	STANDARD:	440-450	372	93.000	.15uH
		450-460	385	96.250	.10uH
		460-470	392	98.000	.10uH

REFERENCE DESIGNATORS, THIS PAGE:

AR1	
C72-C95, C98, C99, C101-C105, C150, C151, C154	
CR14, CR15	Q5-Q8
FL3, FL10	R50-R54, R63-R77,R86,R88
HR1	RT1
J7, J10	T1
L9-L16	VR1
P1, P2	Y1

FLAGS, THIS PAGE: T4

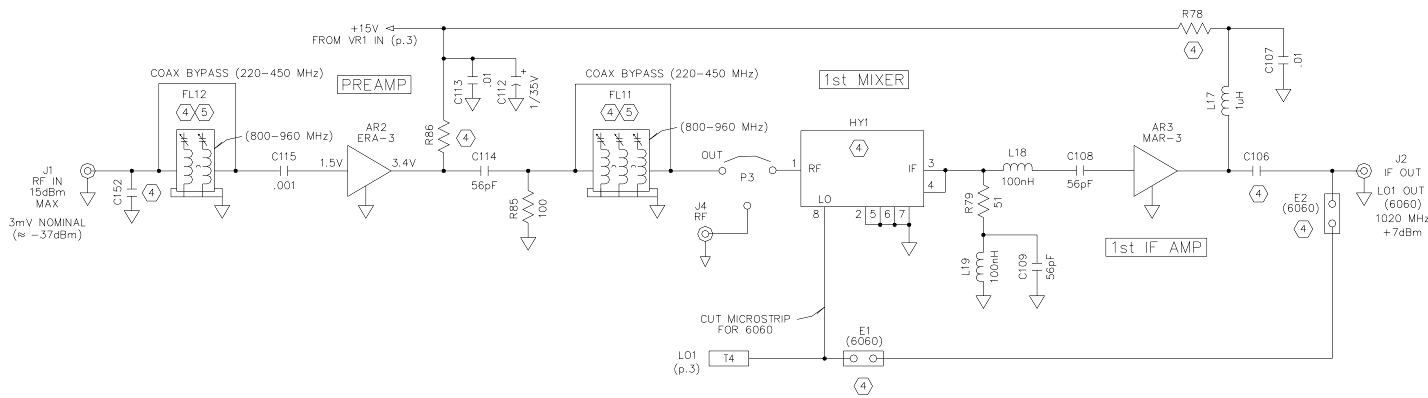
(4) R67: SELECT IN TEST FOR LO PWR= +10dBm (+/- 2dBm) POST-FILTER AS REQ'D. 470 ≤ R67 ≤ 1K

(3) SELECT IN TEST (10pF AS REQ'D)

NOTES UNLESS OTHERWISE SPECIFIED

600-10228-01 Rev K

Receiver RF Module Schematic, p. 3 of 4



CONFIGURATION	CARRIER MHz	LO MHz	Y1 MHz (p.3)	L10 (p.3)	FL10 (p.3)	FL11 (4)	FL12 (4)
950 MHz BAND — STANDARD:	940–960	1020	102.000	.10uH	1271	1259	2737
	920–940	1000	100.000	.10uH	1271	1259	2737
	910–920	980	98.000	.10uH	1259	1259	2737
	900–910	980	98.000	.10uH	1259	1278	2737
	880–900	960	96.000	.10uH	1259	1278	2737
	860–880	940	94.000	.10uH	1259	1278	2737
	840–860	920	92.000	.10uH	1259	1328	2774
1.7 GHz BAND — STANDARD:	840–860	920	92.000	.10uH	1259	1328	2774
	820–840	900	90.000	.10uH	1278	1328	2774
	800–820	880	88.000	.10uH	1278	1328	2774
	780–800	860	86.000	.15uH	—	—	—
	760–780	840	84.000	.15uH	—	—	—
	740–760	820	82.000	.15uH	—	—	—

(5)

BAND	HY1	R86	R78	C106	FL12	FL11	E1	E2	C152
6020/6030 950 MHz	SRA12	360	360	.01	(SEE CONFIG CHART) (5)		NI	NI	1.0pF
6060 950 MHz	N/A	NI	NI	NI	NA		JUMPER	JUMPER	1.0pF
330/450 MHz	RFMX1	360	360	.01	COAX BYPASS		NI	NI	NI
220 MHz	RFMX1	360	360	.01	COAX BYPASS		NI	NI	NI
1.7GHz	RFMX1	360	360	.01	COAX BYPASS		NI	NI	NI

(4)

NI = NOT INSTALLED

REFERENCE DESIGNATORS, THIS PAGE:

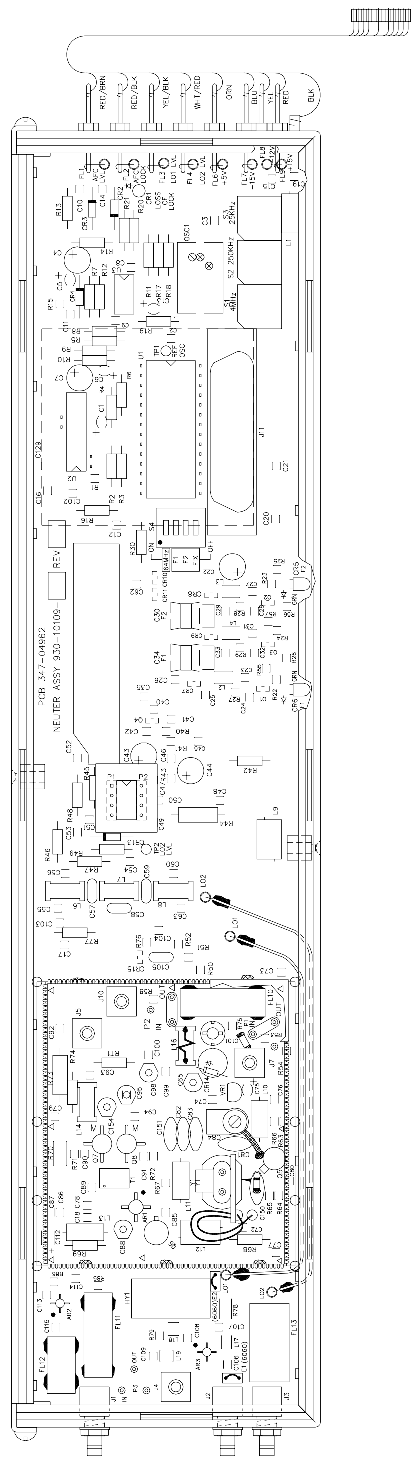
AR2,AR3
C106–C109, C112–C115, C152
E1, E2
FL11, FL12
HY1
J1, J2, J4
L17–L19
P3
R78, R79, R85, R86
Z2

FLAGS, THIS PAGE:

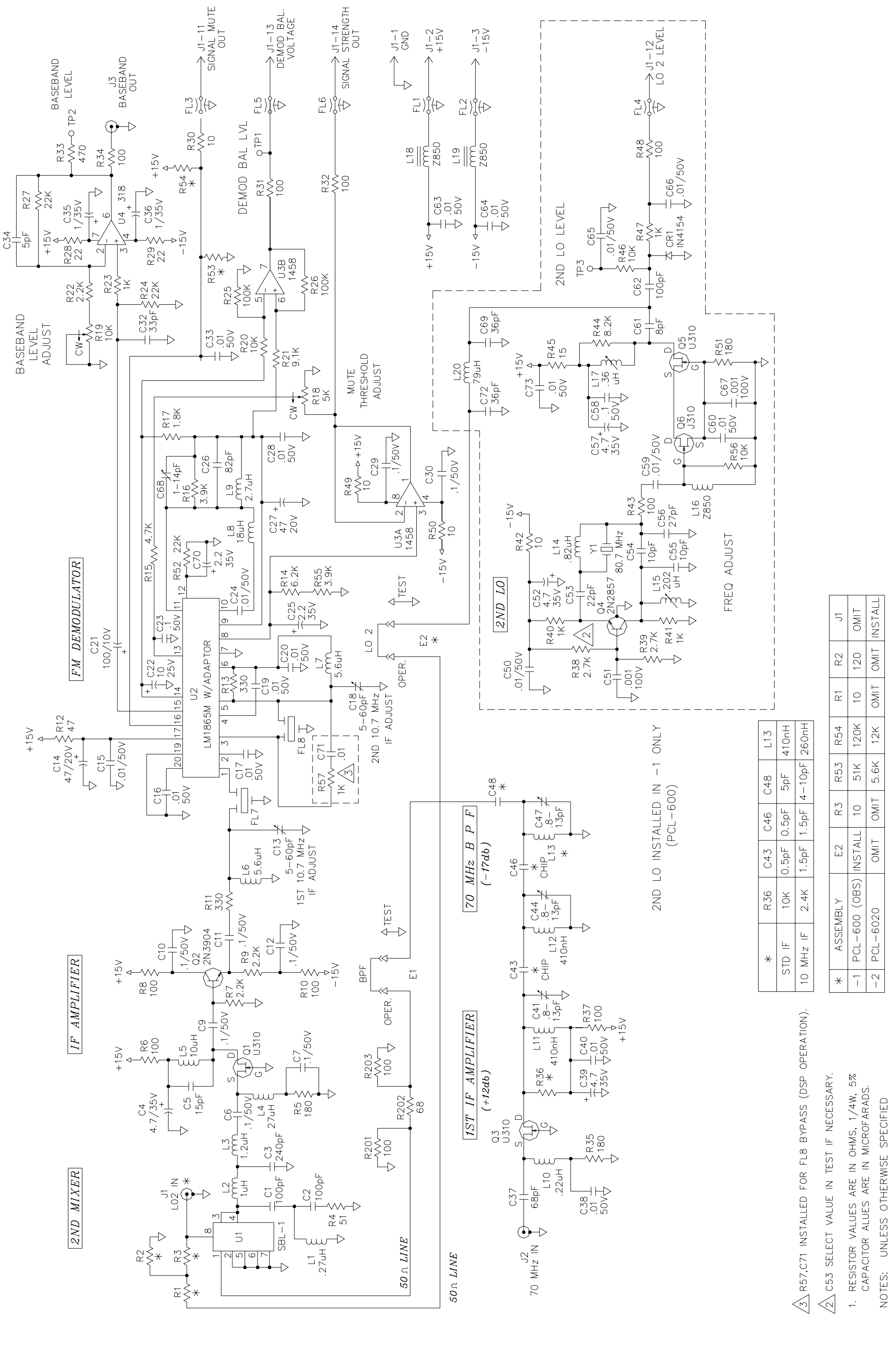
T4

600-10228-01 Rev K

Receiver RF Module Schematic, p. 4 of 4

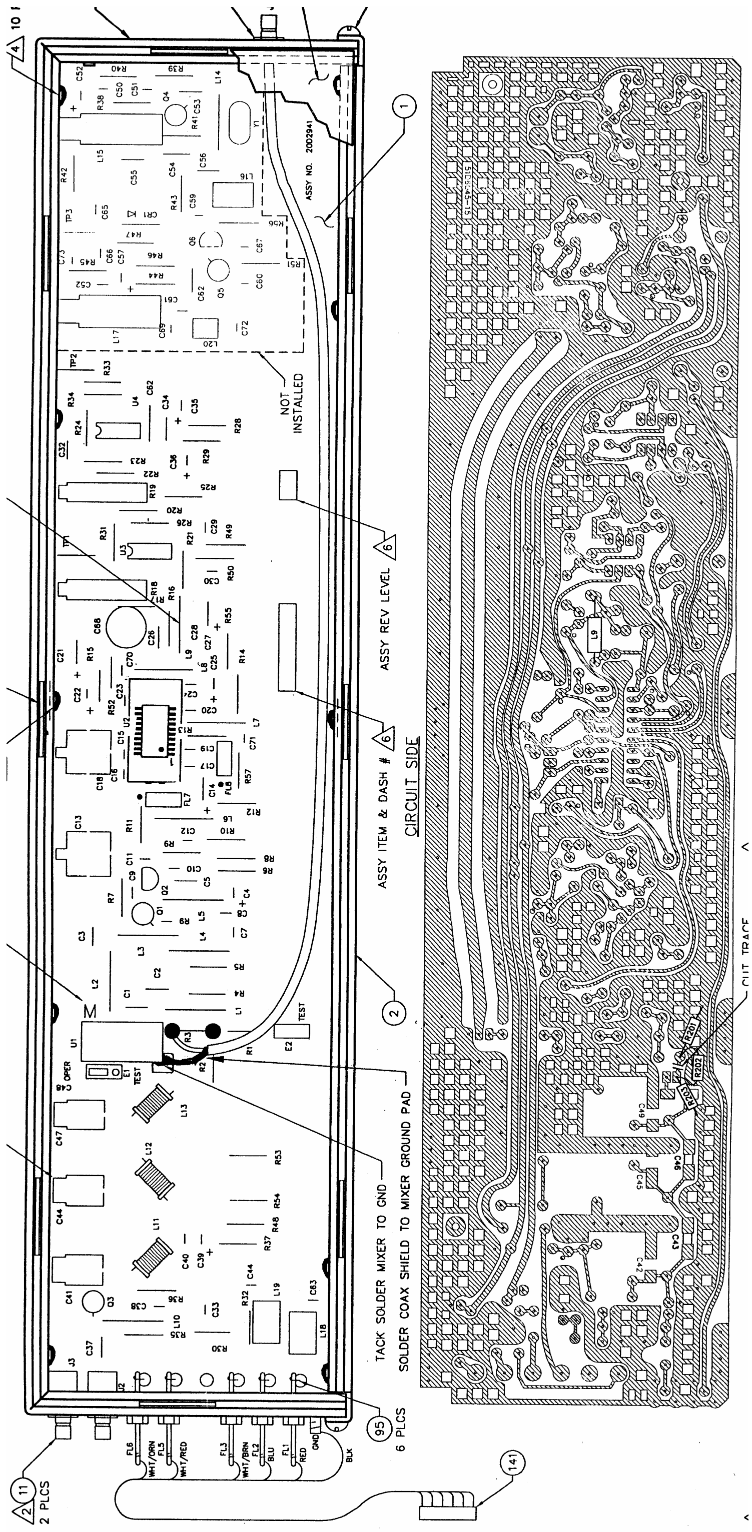


930-03595-01 Rev J
Receiver RF Module (6030) Assembly

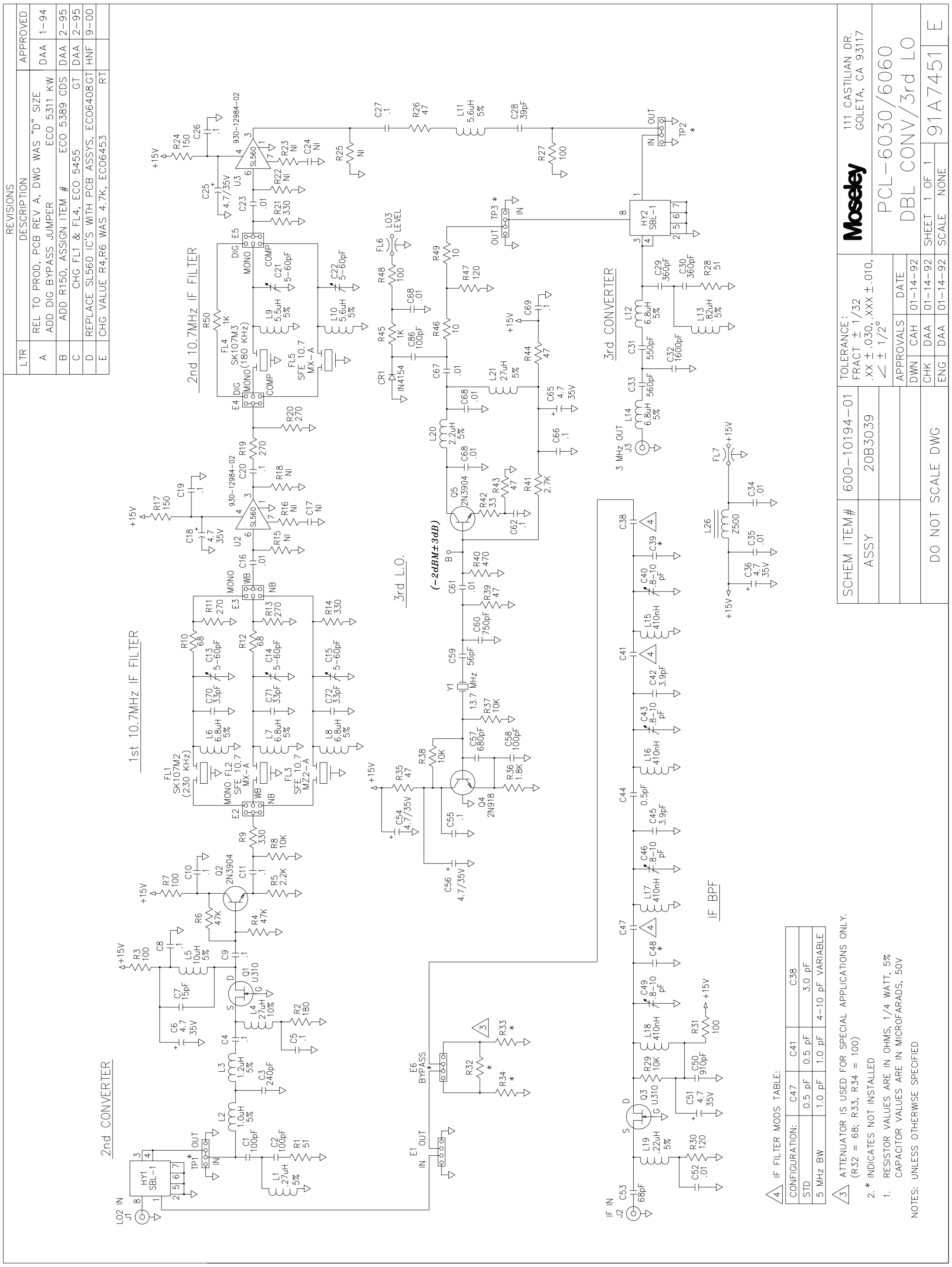


91B7375 Rev C

IF Demod (6020) Schematic

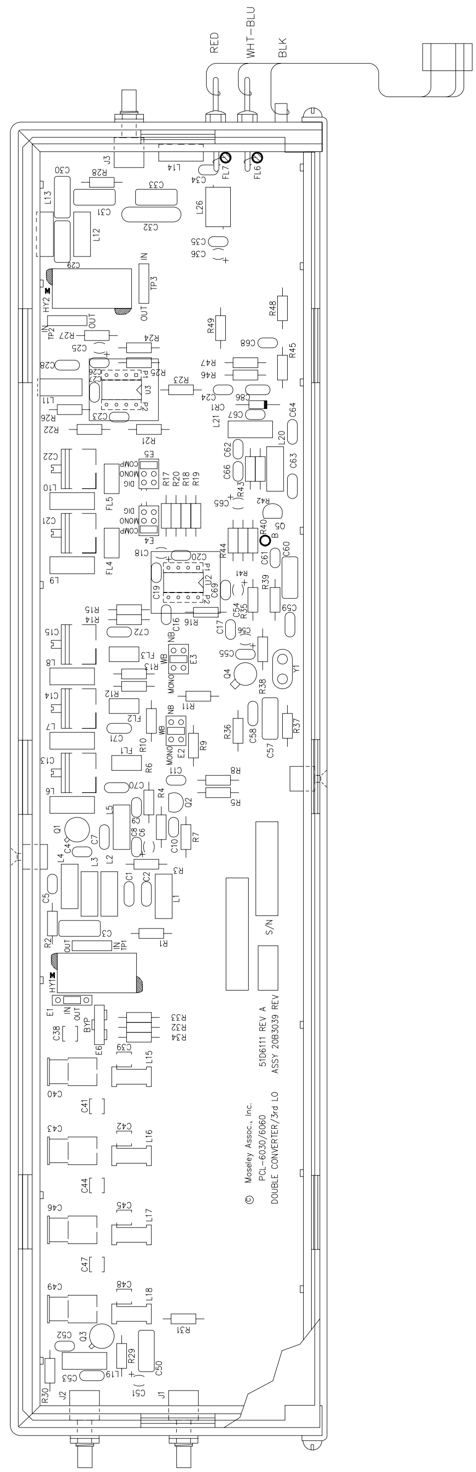


20B2941 Rev C
IF DEMOD (6020) Assembly

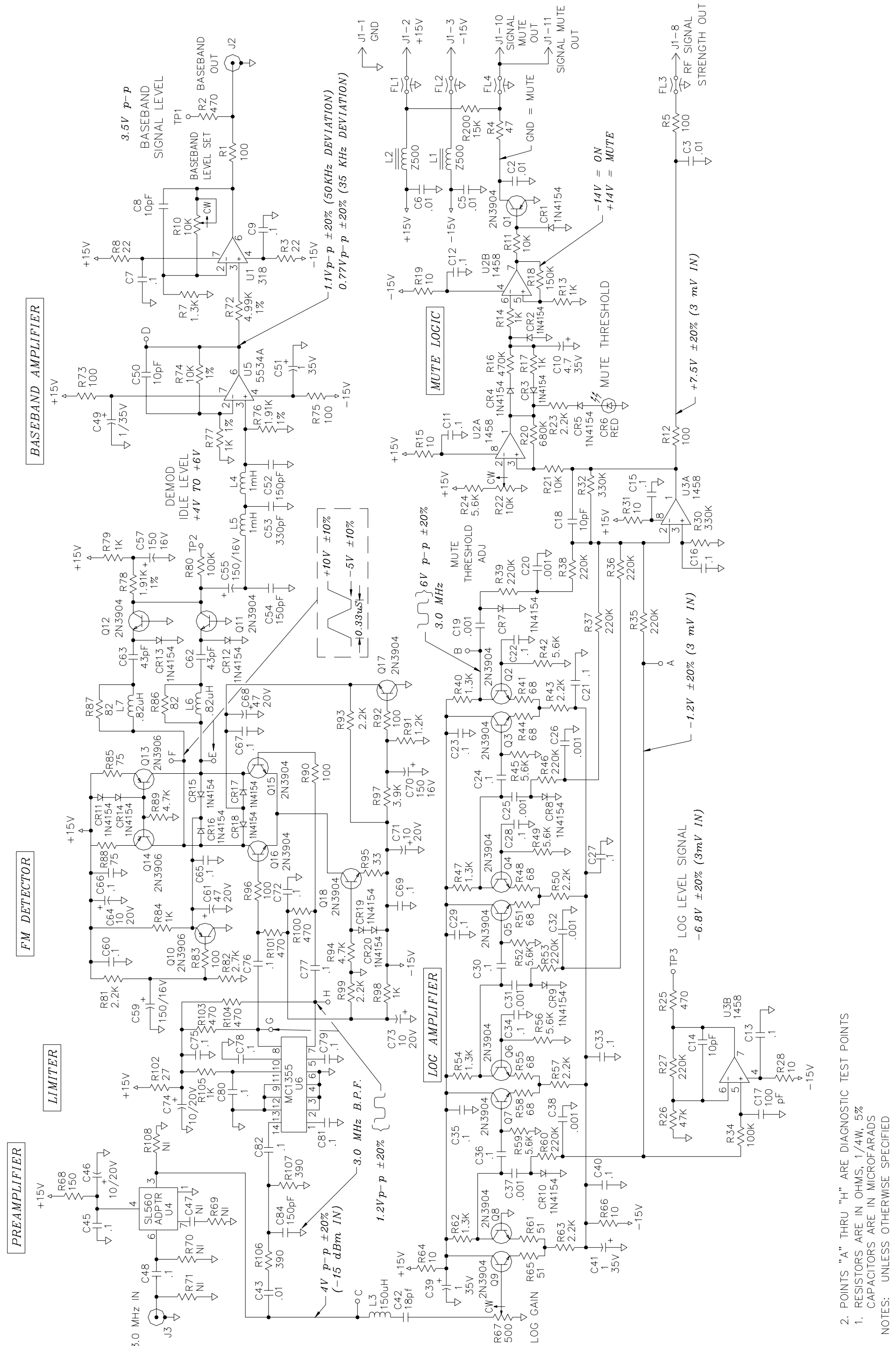


91B7451 Rev E

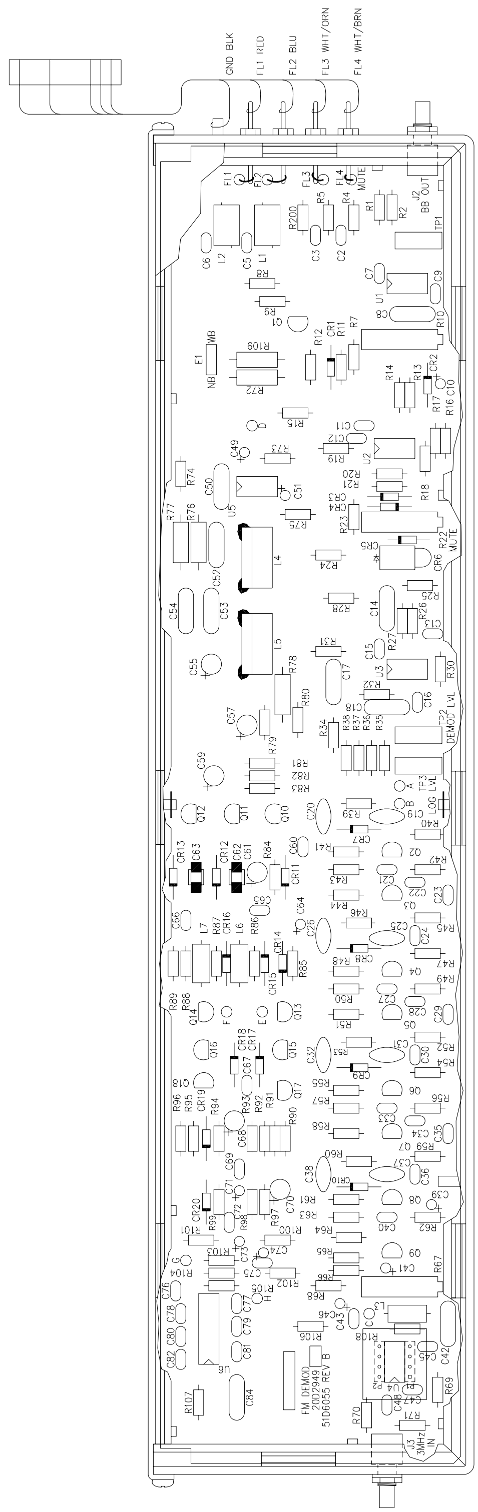
Double Converter/LO3 (6030) Schematic



20B3039 Rev E
Double Converter/LO3 (6030) Assembly



91B7387 Rev F
FM Demod (6030) Schematic



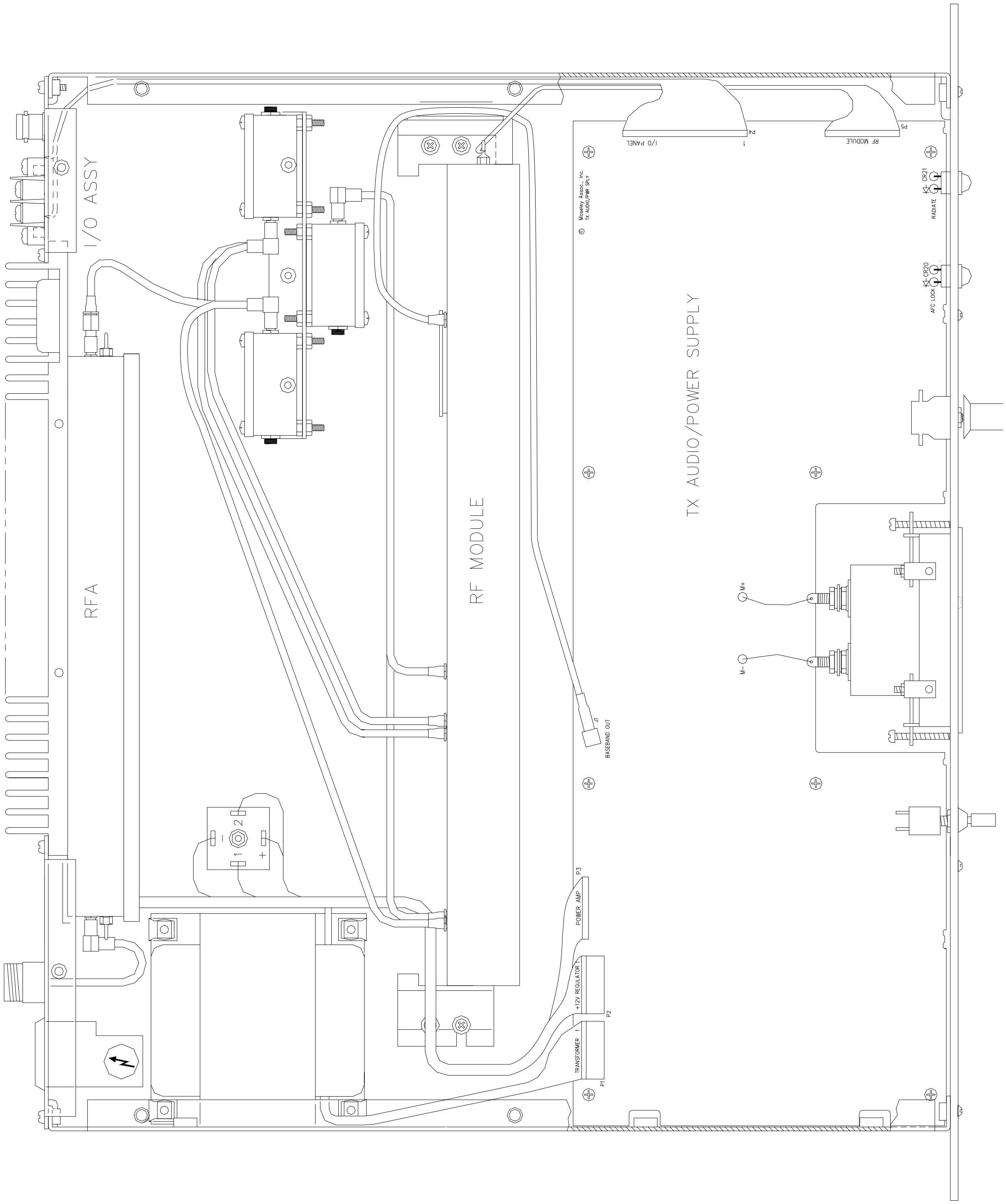
20B2949 Rev G
FM Demod (6030) Assembly

7.2 PCL 6000-330/450 STD

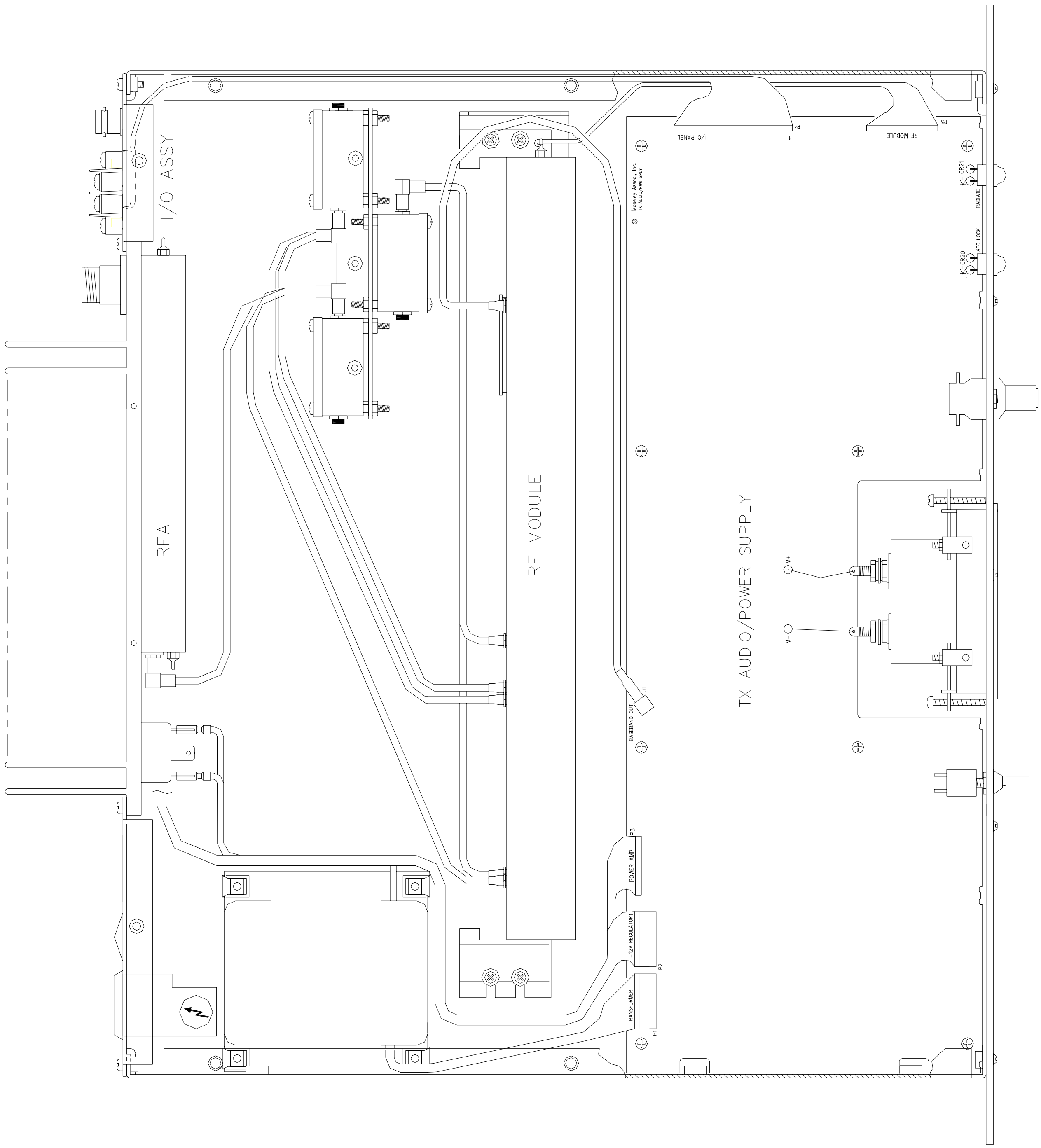
DESCRIPTION	ENG. DWG. No.	REV LEVEL	REV DATE
Transmitter Final Assembly (330MHz)	21B2890-4	D	08-95
Transmitter Final Assembly (450MHz)	21B2890-5	D	08-95
Transmitter Audio/Power Supply Schematic	91B7444	D	08-95
Transmitter Audio/Power Supply Assembly	20B3023	D	08-95
Transmitter RF Module Schematic	600-10227-01	H	08-95
Transmitter RF Module Assembly	930-03462-01	H	08-95
RF Amplifier Schematic (330MHz)	91A7459	A	08-95
RF Amplifier Assembly (330MHz)	20B3038	A	08-95
RF Amplifier Schematic (450MHz)	91C7396	B	08-95
RF Amplifier Assembly (450MHz)	20B2958	D	08-95
6020 Receiver Final Assembly (330/450)	21B2891-4	D	08-95
6030 Receiver Final Assembly (330/450)	21B2892-4	D	08-95
Receiver Audio/Power Supply Schematic	600-10710-01	B	08-95
Receiver Audio/Power Supply Assembly	20B3024	C	08-95
Receiver RF Module Schematic	600-10228-01	K	08-95
Receiver RF Module (6030) Assembly	20B3107-3	B	08-95
IF Demod (6020) Schematic	91B7375	C	08-95
IF Demod (6020) Assembly	20B2941-2	C	08-95
Double Converter(6030) Schematic	91B7451	E	08-95
Double Converter(6030) Assembly	20B3039	E	08-95
FM Demod (6030) Schematic	91B7387	F	08-95
FM Demod (6030) Assembly	20B2949	G	08-95

NOTICE:

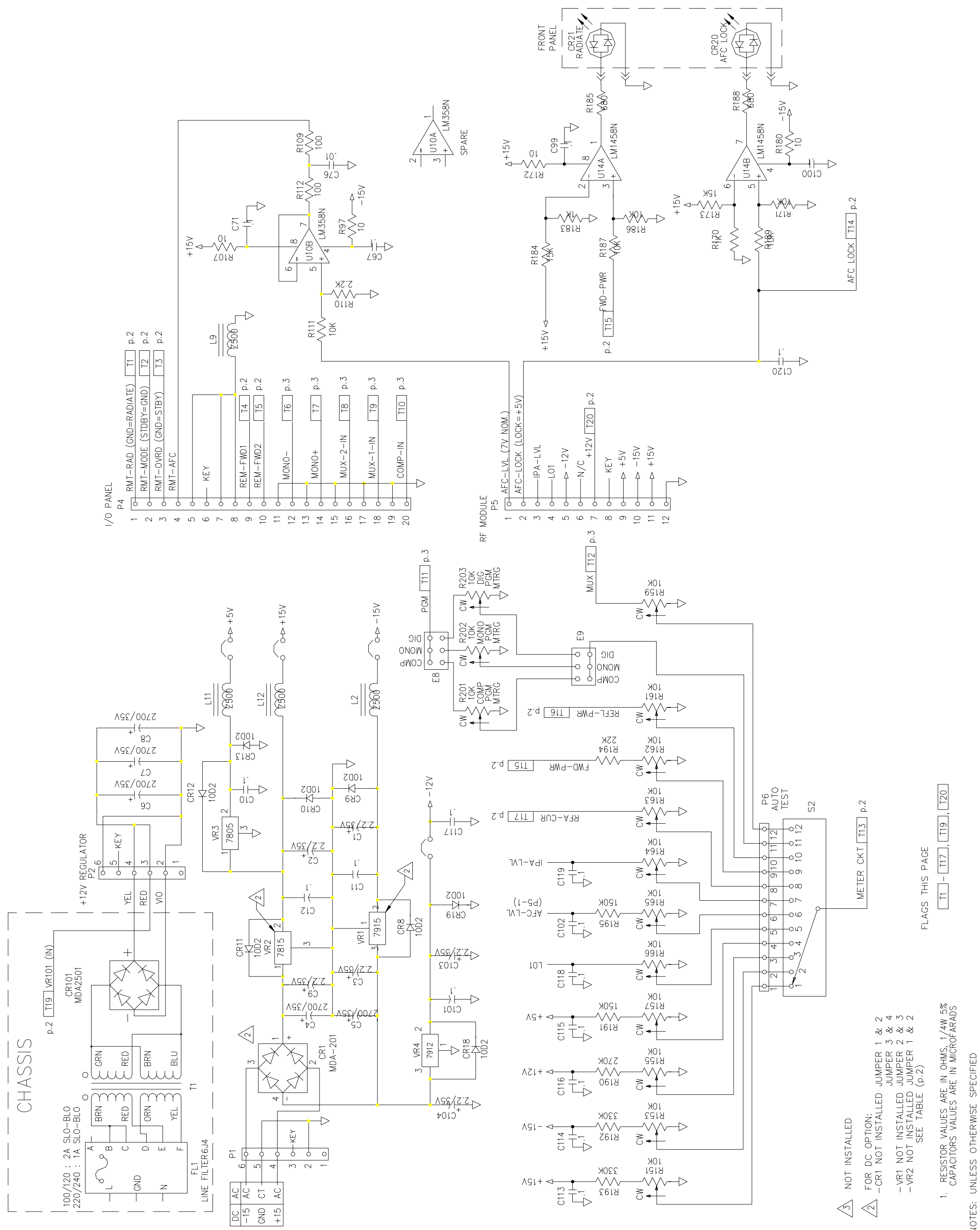
This section contains schematic and assembly drawings referred to in Sections 1 and 4. For information on individual drawings refer to Section 1 under "System Description" and/or Section 4 under "Module Description".



21B2890-4 Rev D
6010 Transmitter Final Assembly (330 MHz)

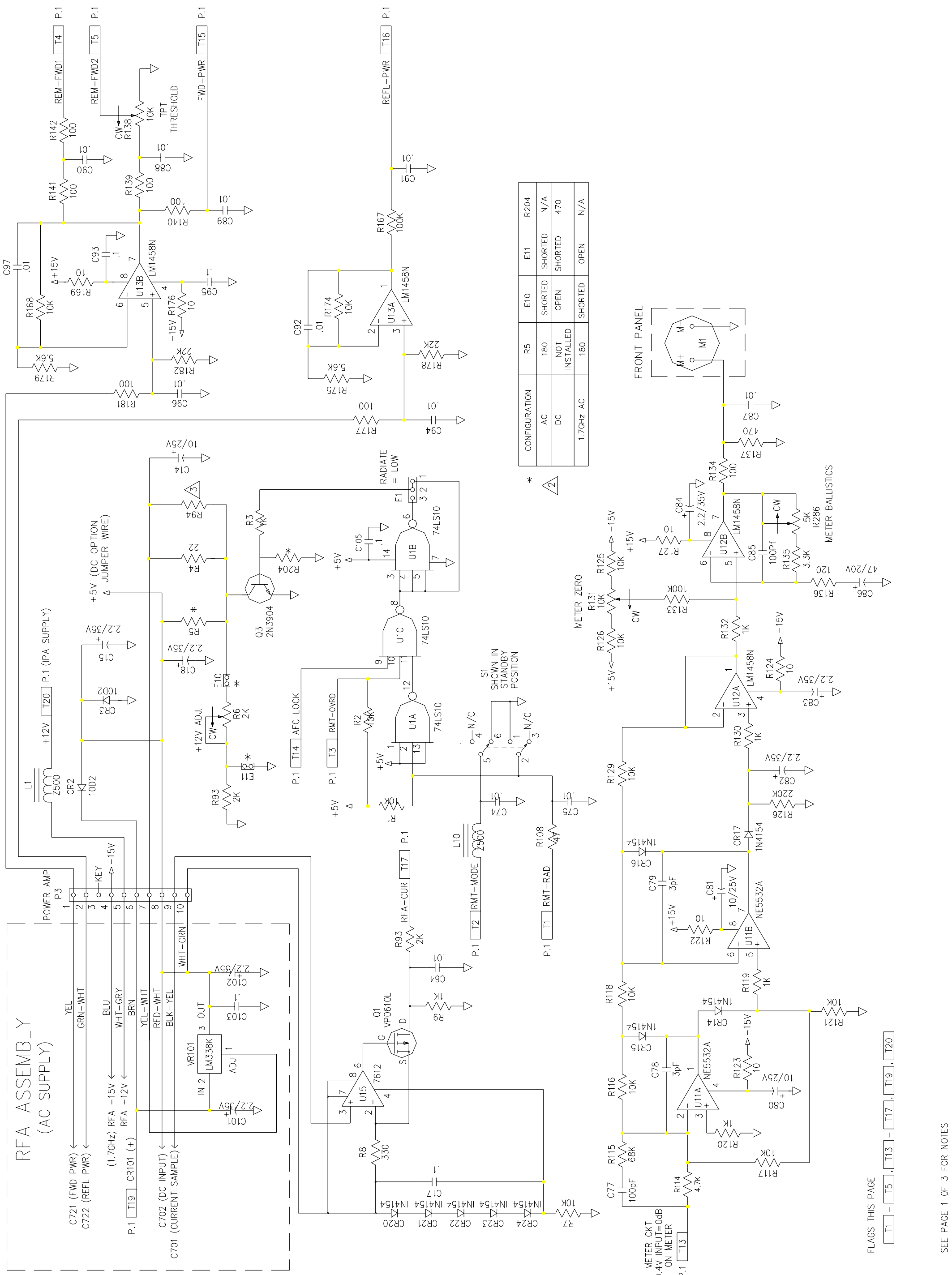


21B2890-5 Rev D
6010 Transmitter Final Assembly (450 MHz)



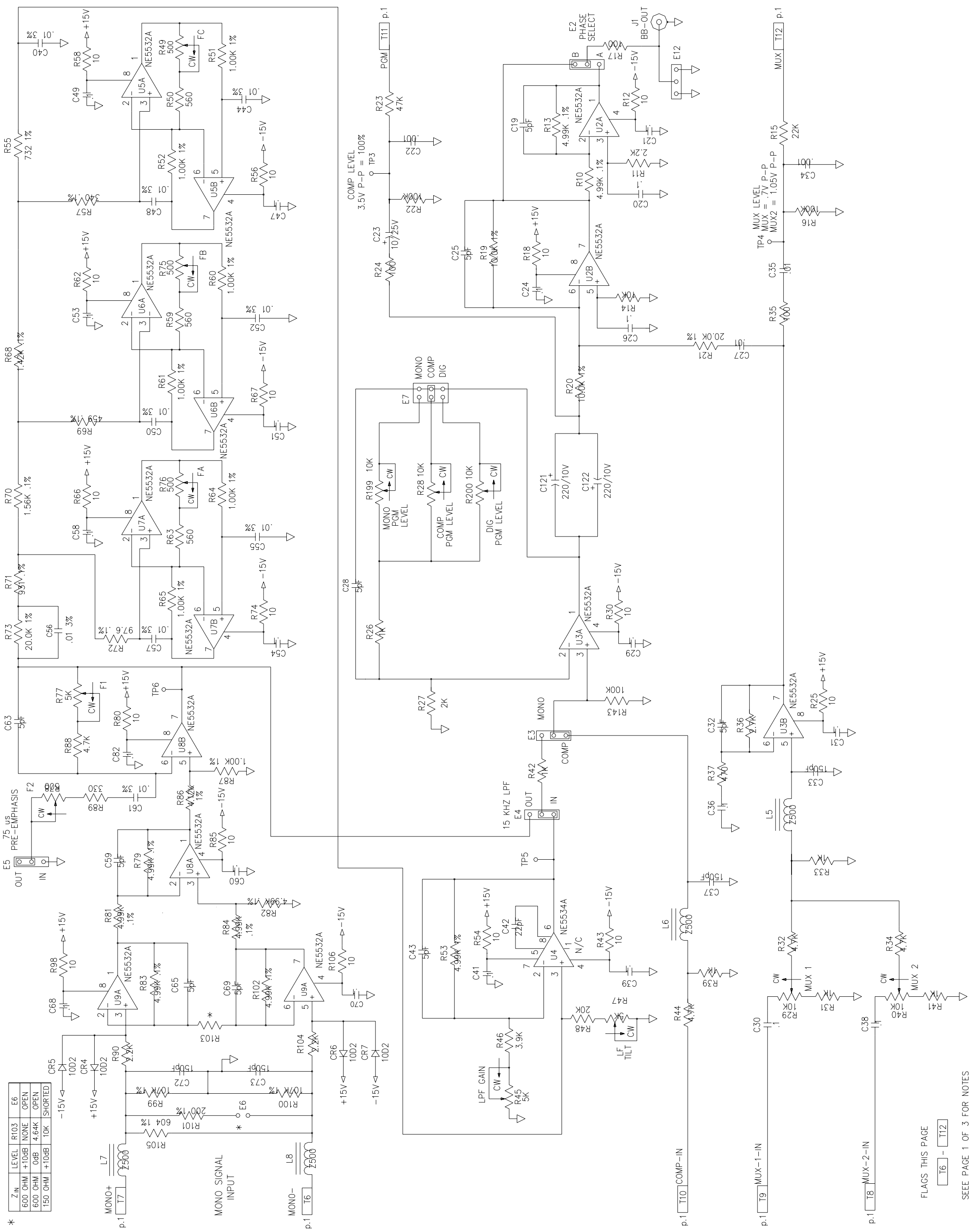
91A7444 Rev D

Transmitter Audio/Power Supply Schematic, p. 1 of 3



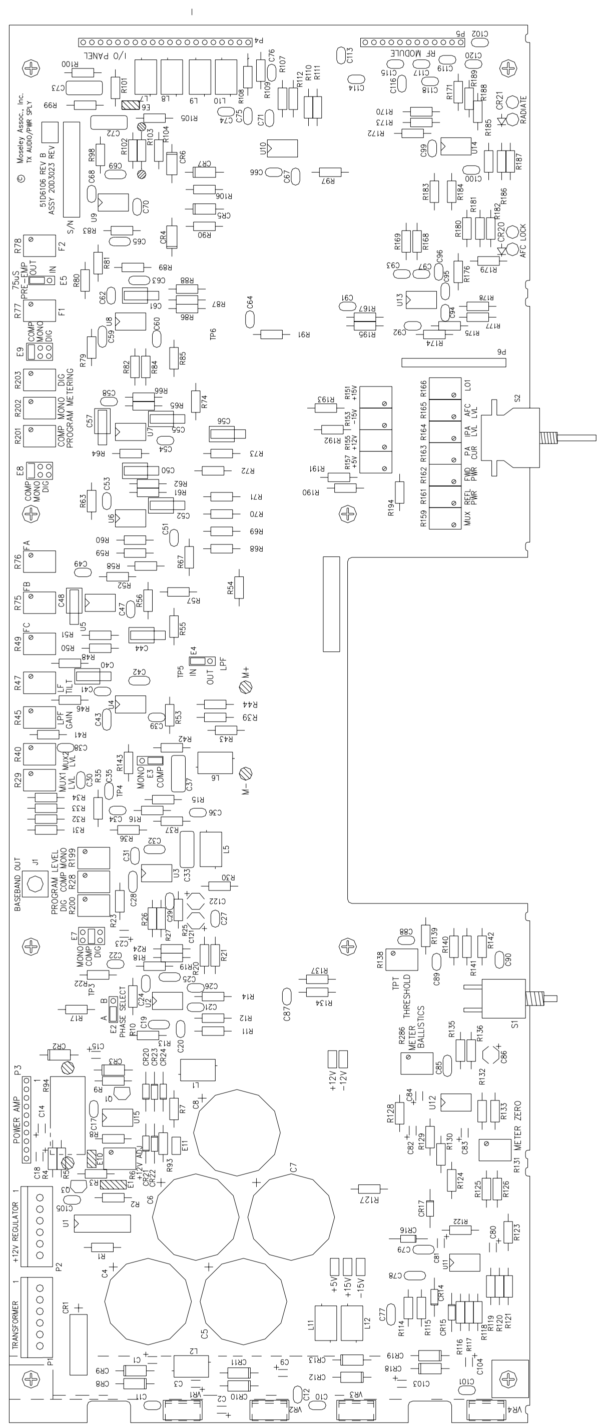
91A7444 Rev D

Transmitter Audio/Power Supply Schematic, p. 2 of 3



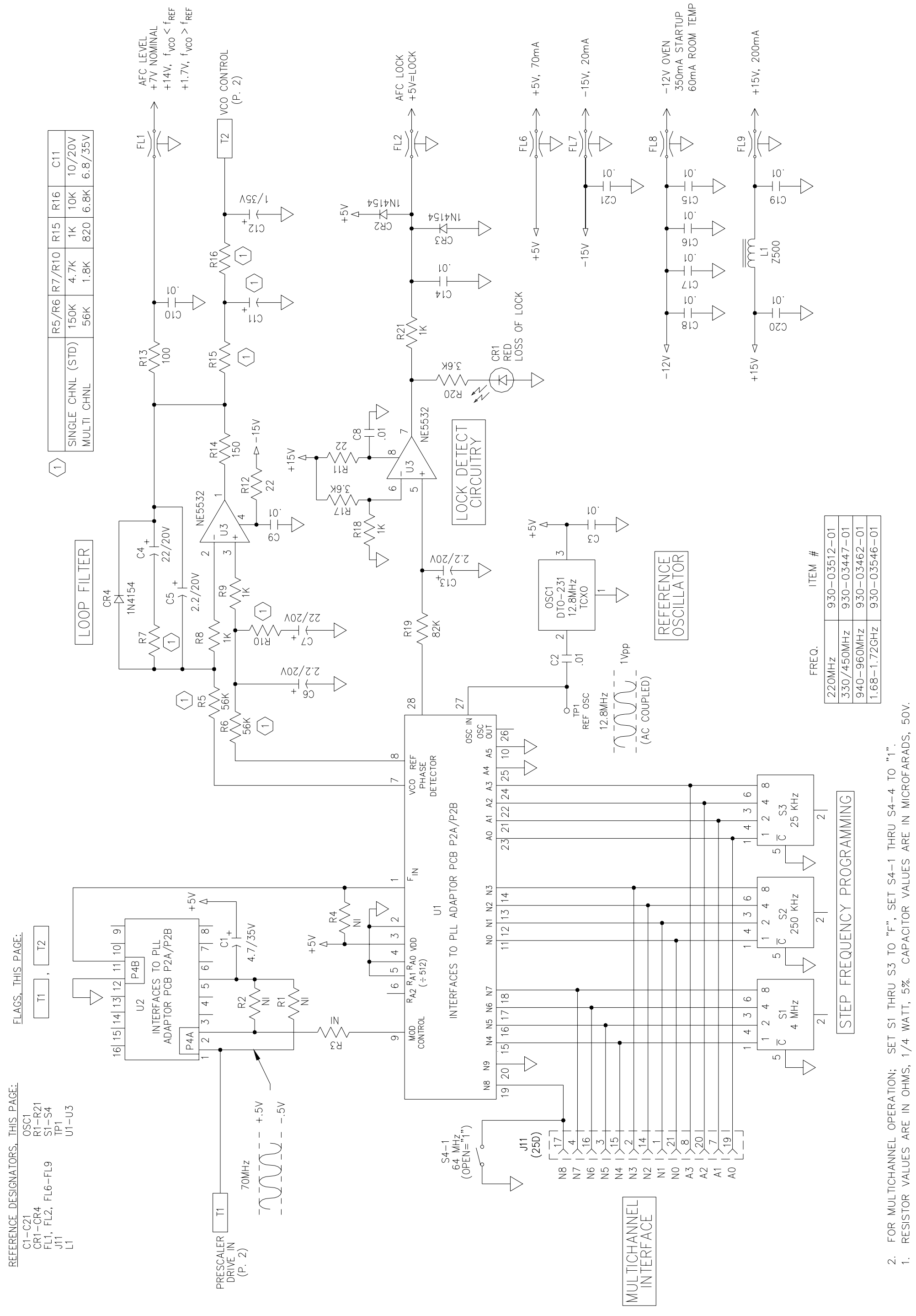
91A7444 Rev D

Transmitter Audio/Power Supply Schematic, p. 3 of 3



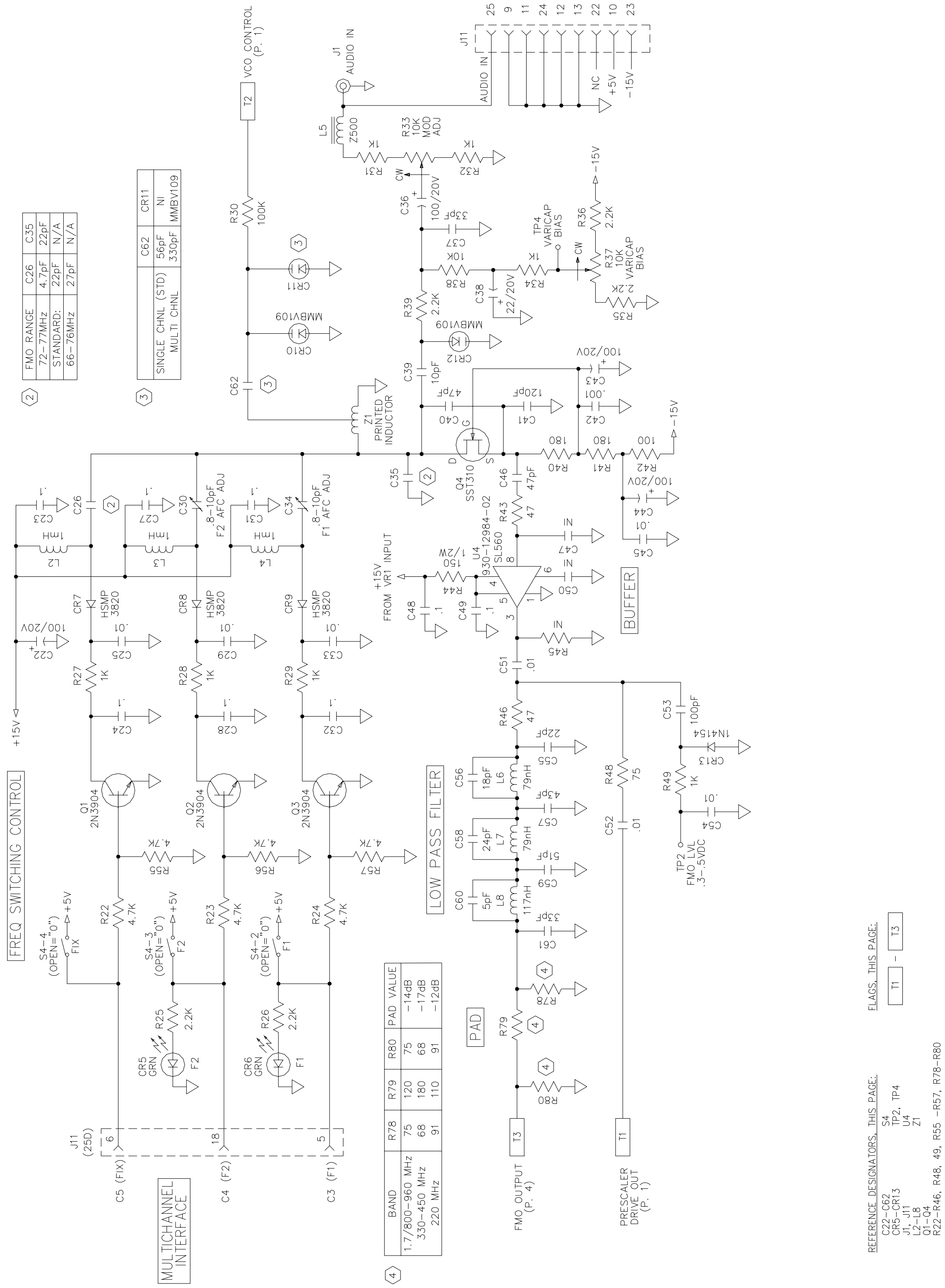
20D3023 Rev D

Transmitter Audio/Power Supply Assembly



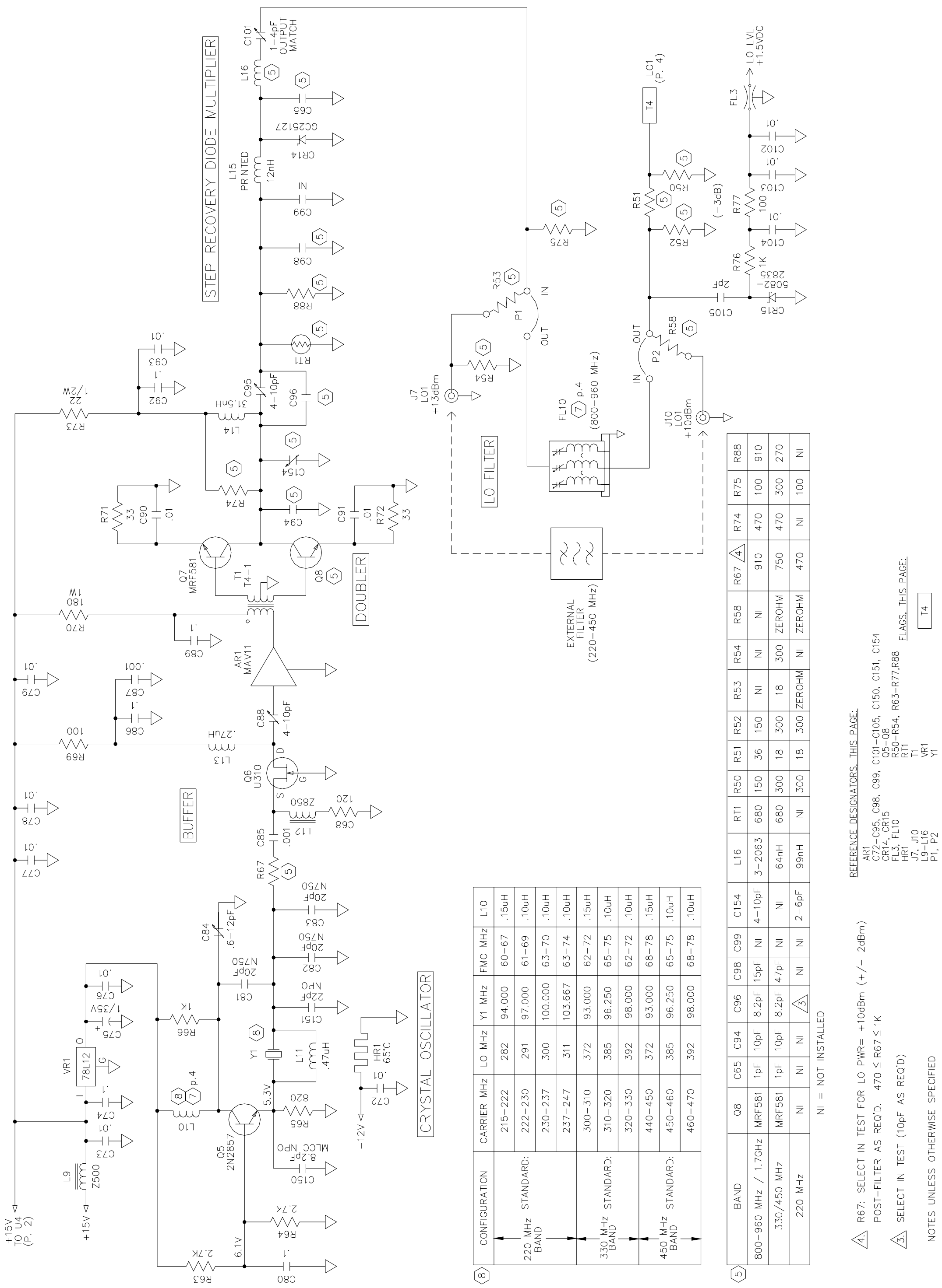
600-10227-01 REV H

Transmitter RF Module Schematic, p. 1 of 4



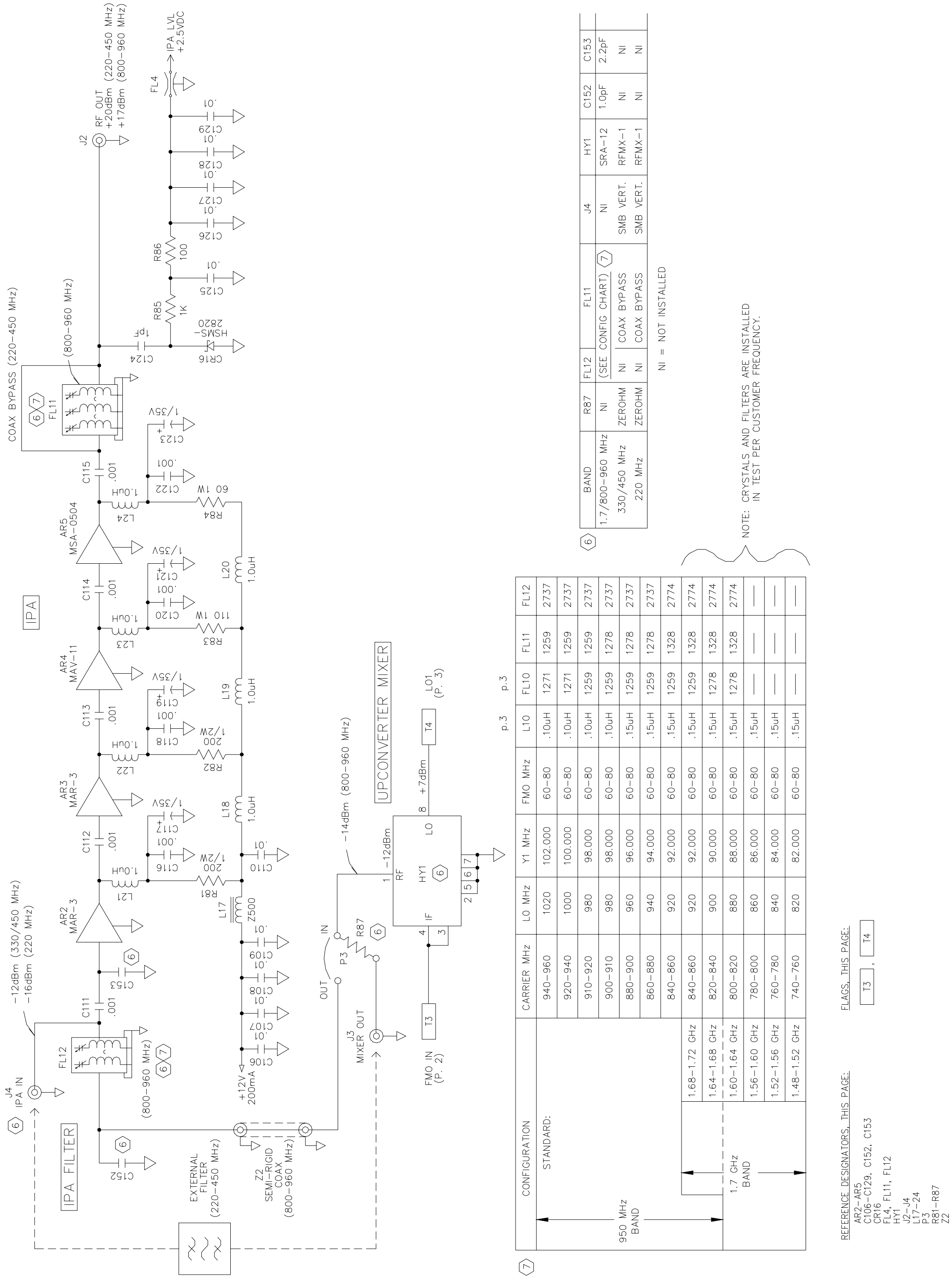
600-10227-01 REV H

Transmitter RF Module Schematic, p. 2 of 4



600-10227-01 REV H

Transmitter RF Module Schematic, p. 3 of 4



BAND	R87	FL12	FL11	J4	HY1	C152	C153
1.7/800-960 MHz	NI	(SEE CONFIG CHART) 7		NI	SRA-12	1.0pF	2.2pF
330/450 MHz	ZEROHM	NI	COAX BYPASS	SMB VERT.	RFMX-1	NI	NI
220 MHz	ZEROHM	NI	COAX BYPASS	SMB VERT.	RFMX-1	NI	NI

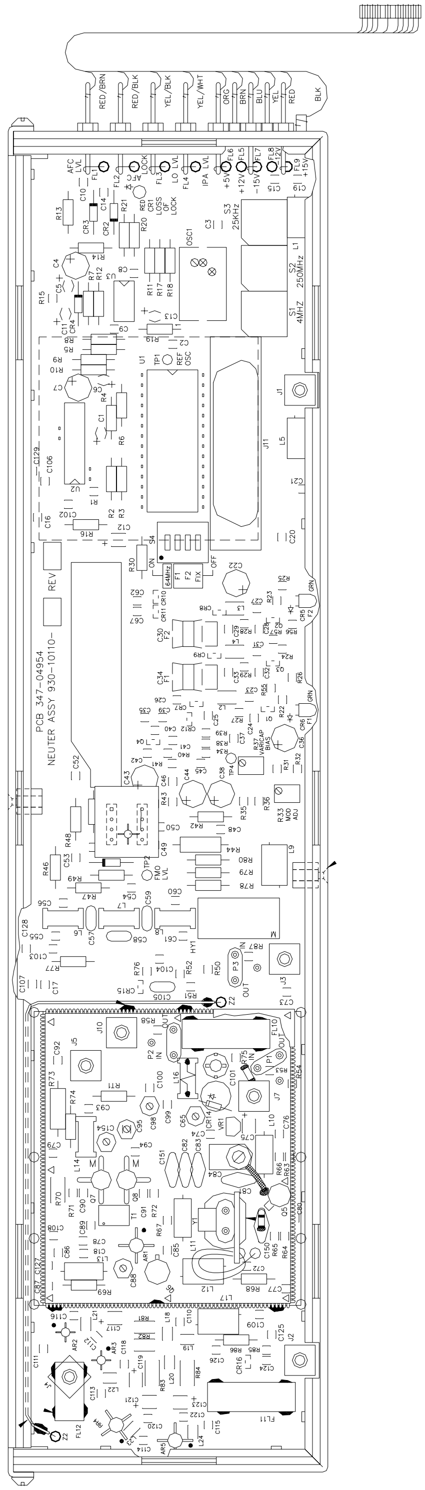
NI = NOT INSTALLED

NOTE: CRYSTALS AND FILTERS ARE INSTALLED IN TEST PER CUSTOMER FREQUENCY.

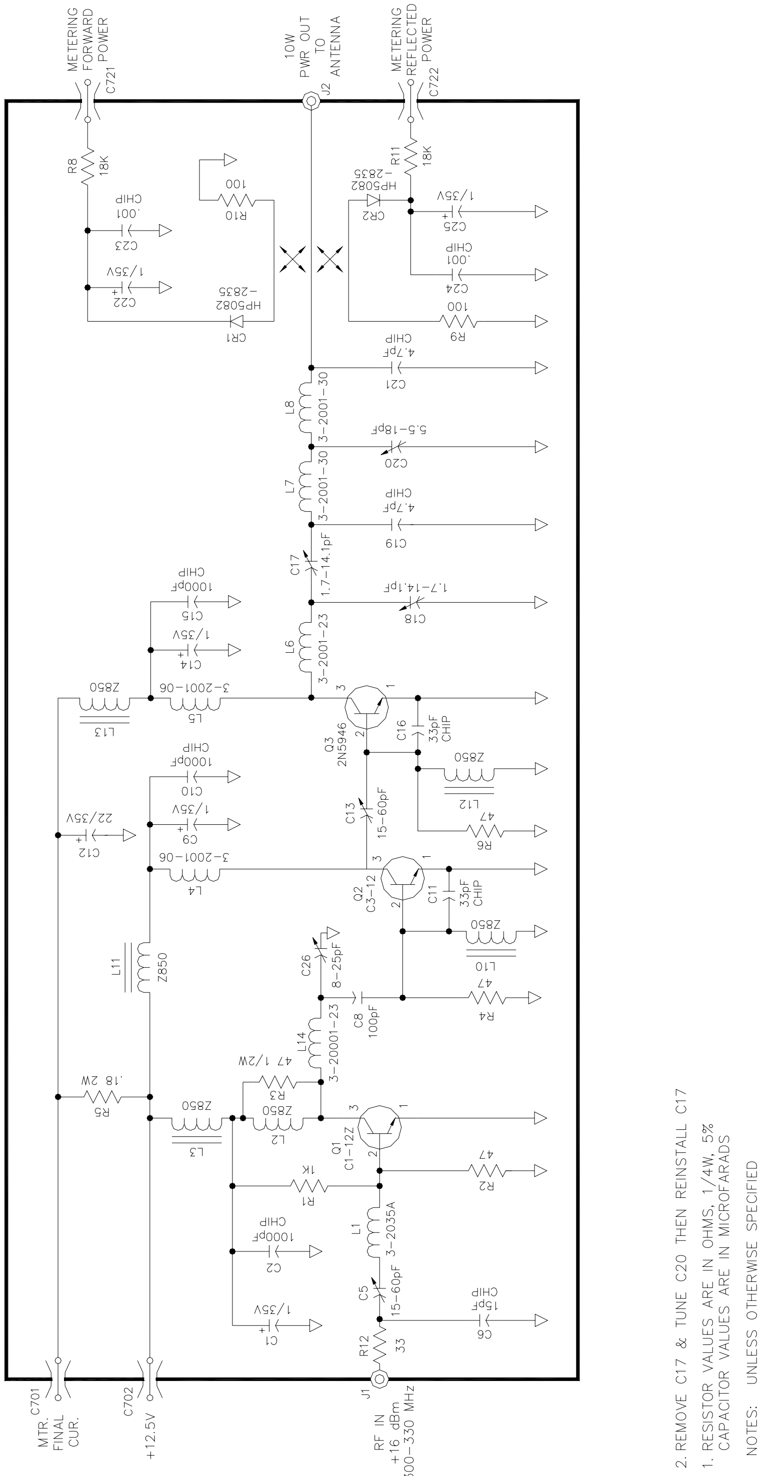
CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz	FMO MHz	L10 (p.3)	FL10 (p.3)	FL11	FL12
STANDARD: 950 MHz BAND		940-960	1020	102.000	60-80	.10uH	1271	1259	2737
		920-940	1000	100.000	60-80	.10uH	1271	1259	2737
		910-920	980	98.000	60-80	.10uH	1259	1259	2737
		900-910	980	98.000	60-80	.10uH	1259	1278	2737
		880-900	960	96.000	60-80	.15uH	1259	1278	2737
		860-880	940	94.000	60-80	.15uH	1259	1278	2737
		840-860	920	92.000	60-80	.15uH	1259	1328	2774
1.7 GHz BAND	1.68-1.72 GHz	840-860	920	92.000	60-80	.15uH	1259	1328	2774
	1.64-1.68 GHz	820-840	900	90.000	60-80	.15uH	1278	1328	2774
	1.60-1.64 GHz	800-820	880	88.000	60-80	.15uH	1278	1328	2774
	1.56-1.60 GHz	780-800	860	86.000	60-80	.15uH	—	—	—
	1.52-1.56 GHz	760-780	840	84.000	60-80	.15uH	—	—	—
	1.48-1.52 GHz	740-760	820	82.000	60-80	.15uH	—	—	—

600-10227-01 REV H

Transmitter RF Module Schematic, p. 4 of 4

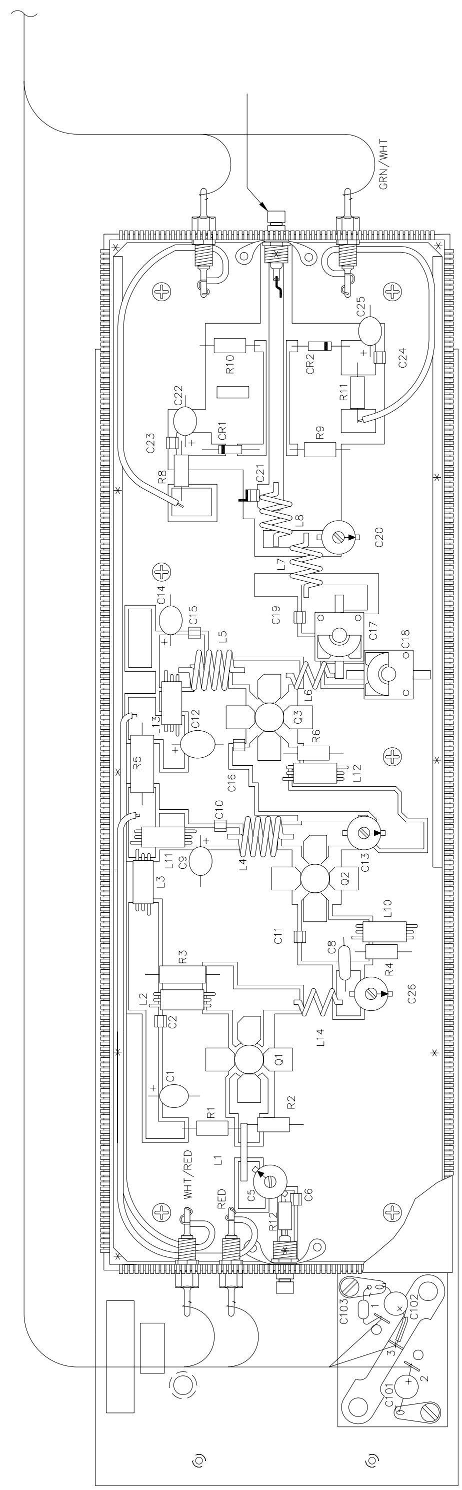


930-03462-013 Rev H
Transmitter RF Module Assembly



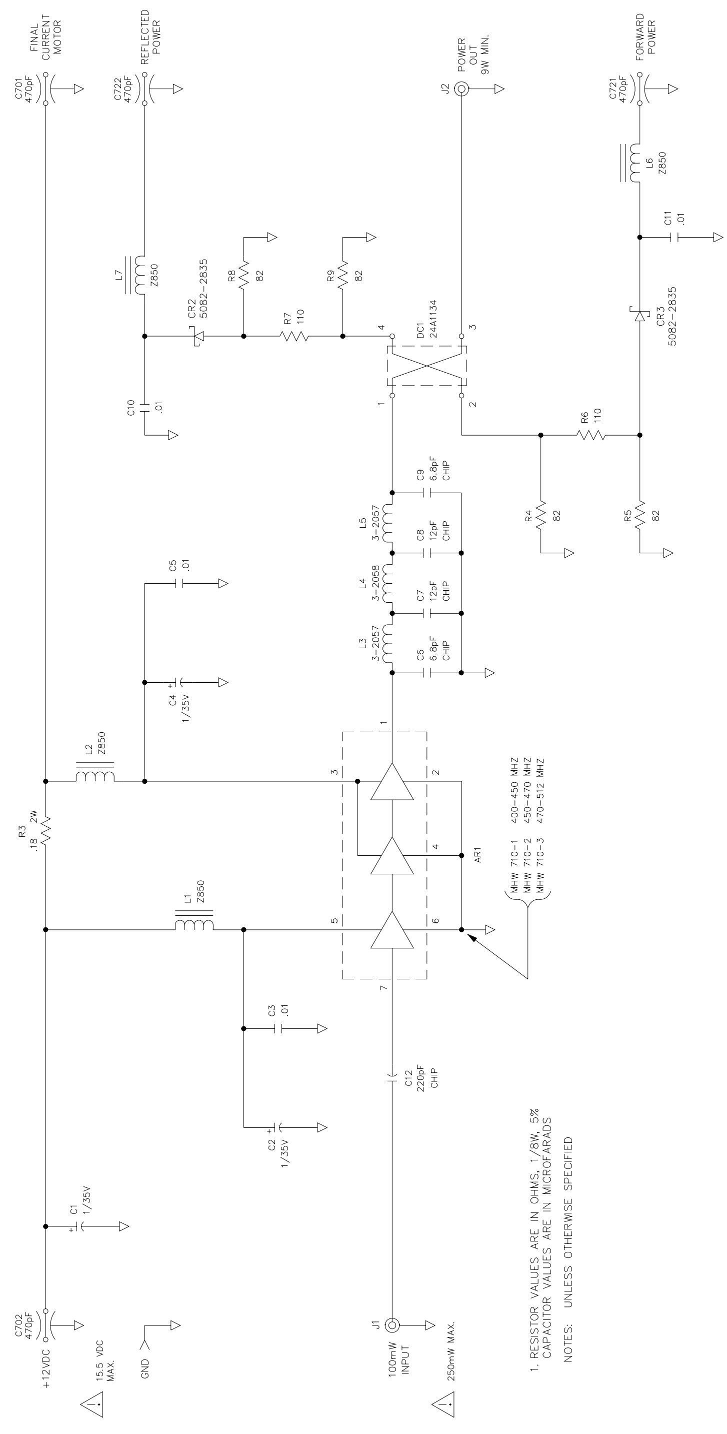
91A7459 Rev A

RF Amplifier (330 MHz) Schematic



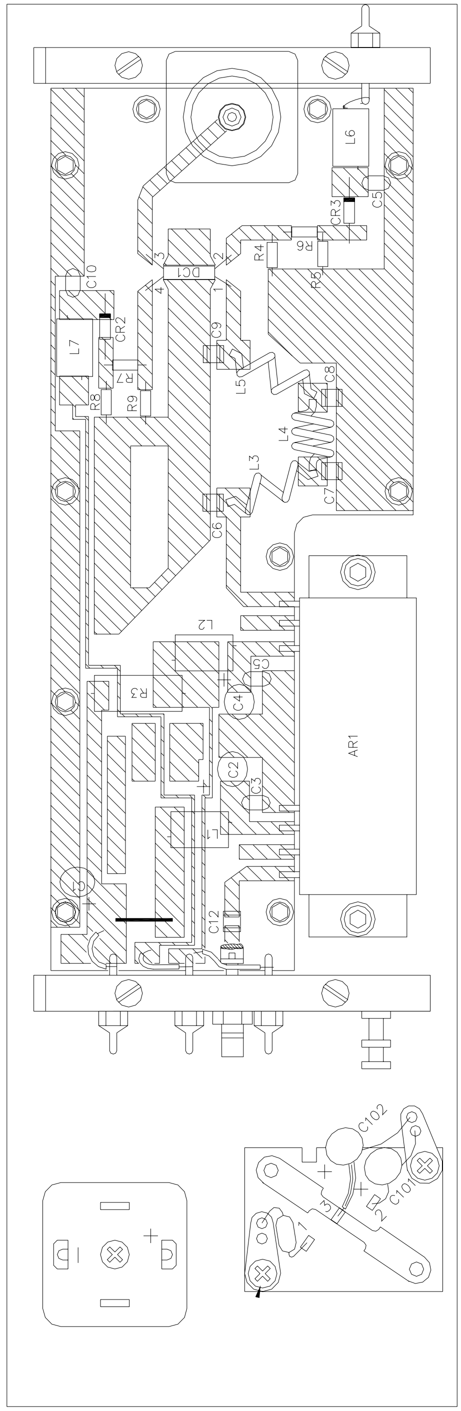
20B3038 Rev A

RF Amplifier (330 MHz) Assembly



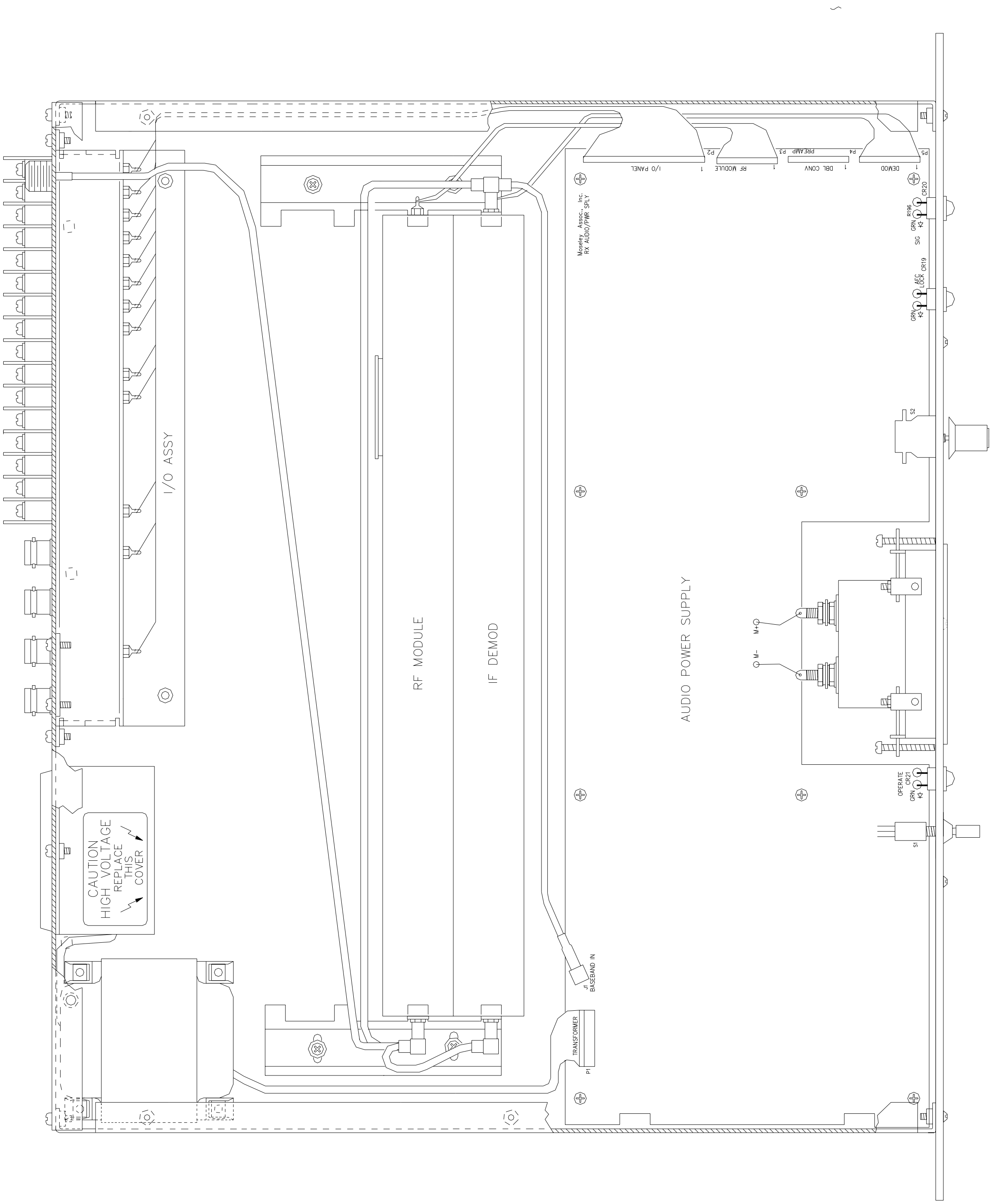
91C7396 Rev B

RF Amplifier (450 MHz) Schematic

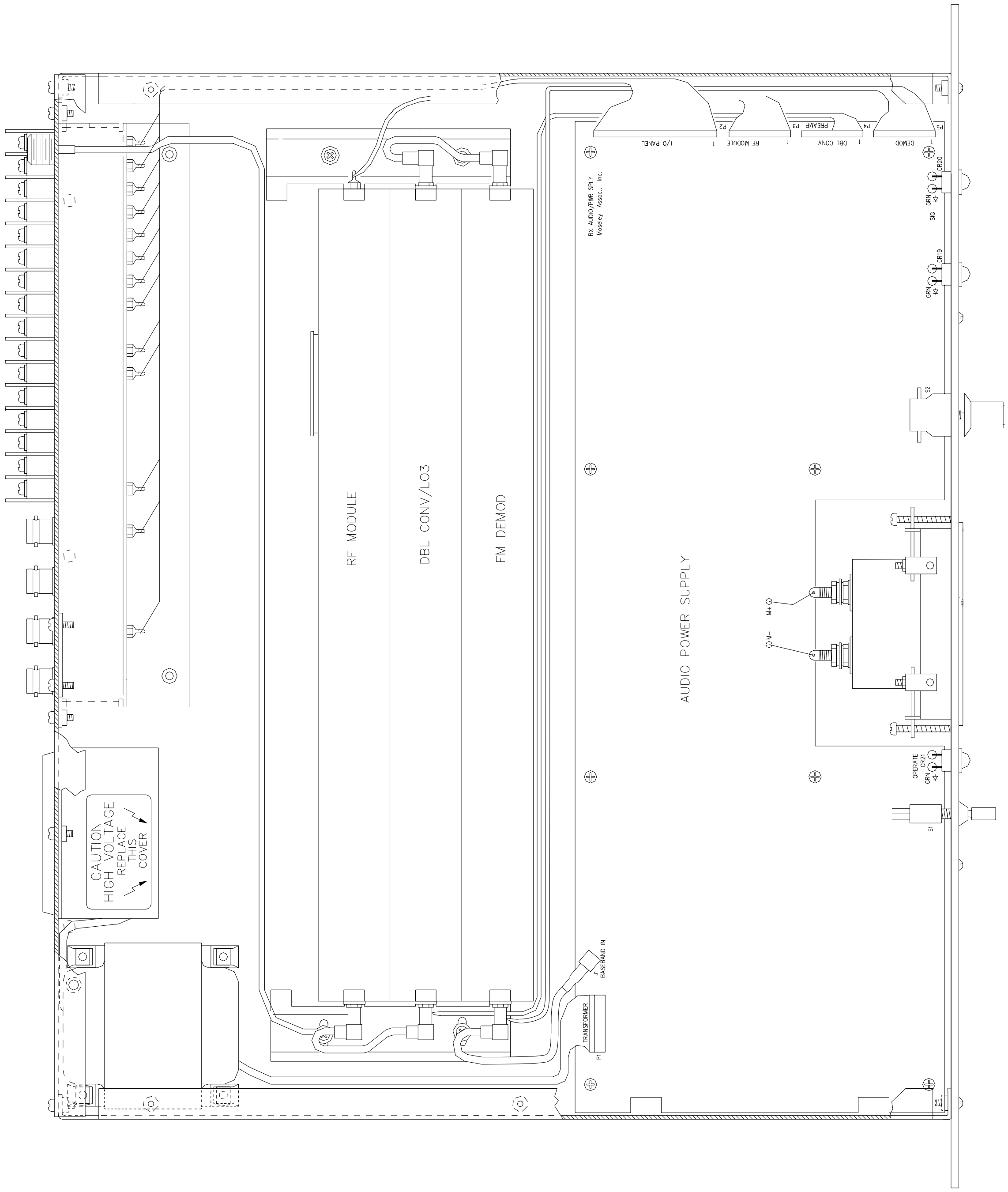


20B2958 Rev D

RF Amplifier (450 MHz) Assembly

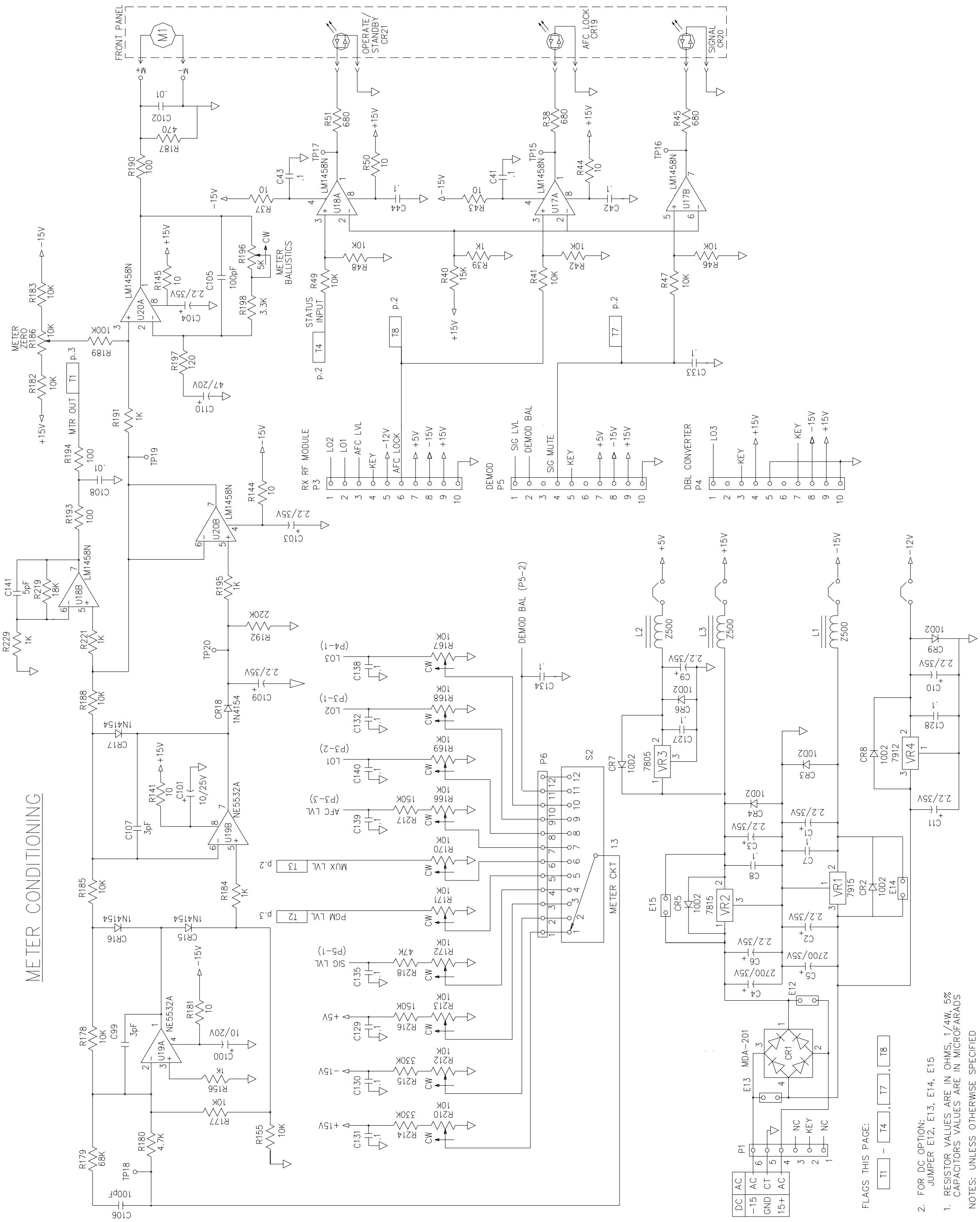


21B2891-4 Rev D
6020 Receiver Final Assembly



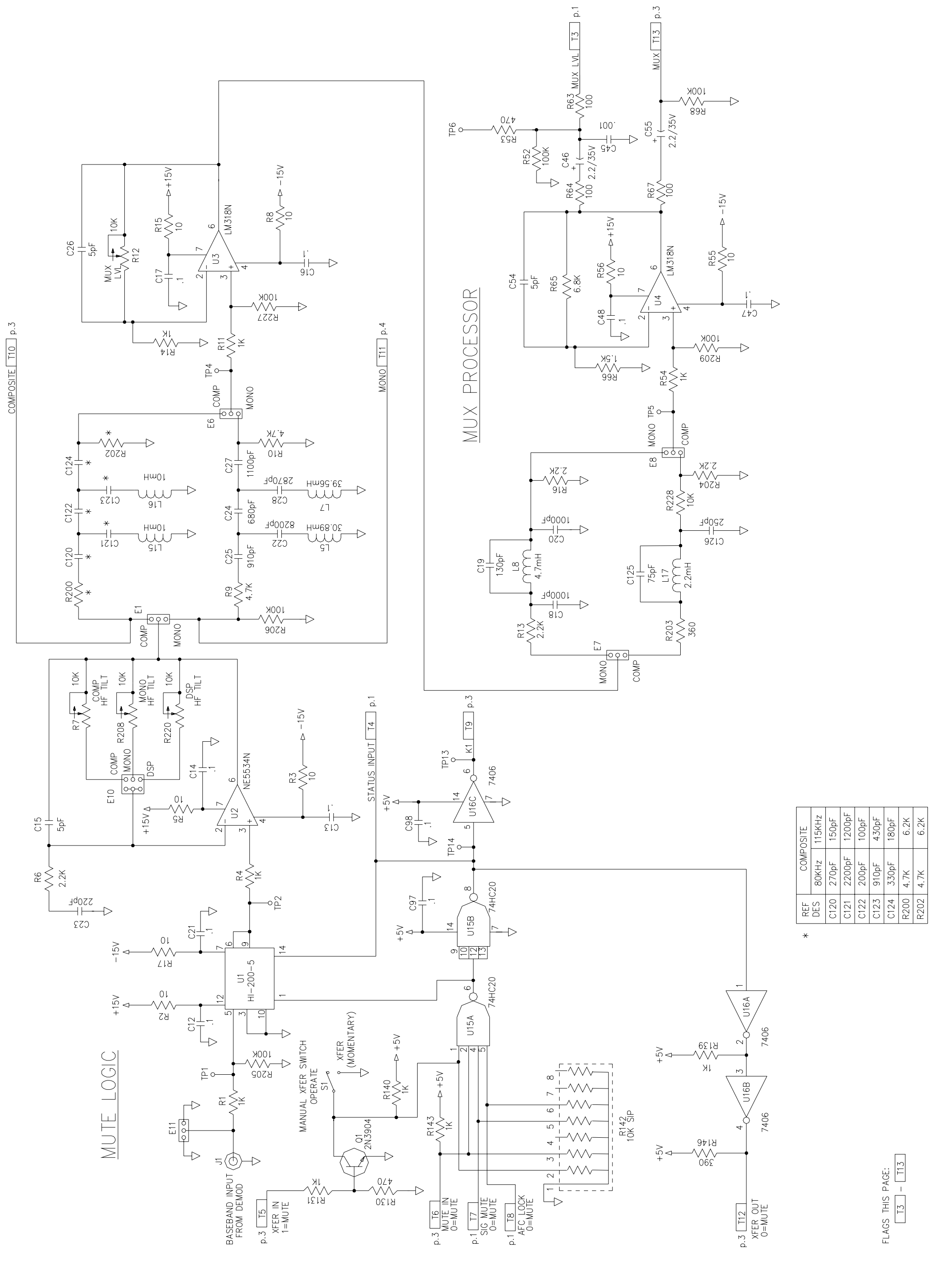
21B2892-4 Rev D

6030 Receiver Final Assembly



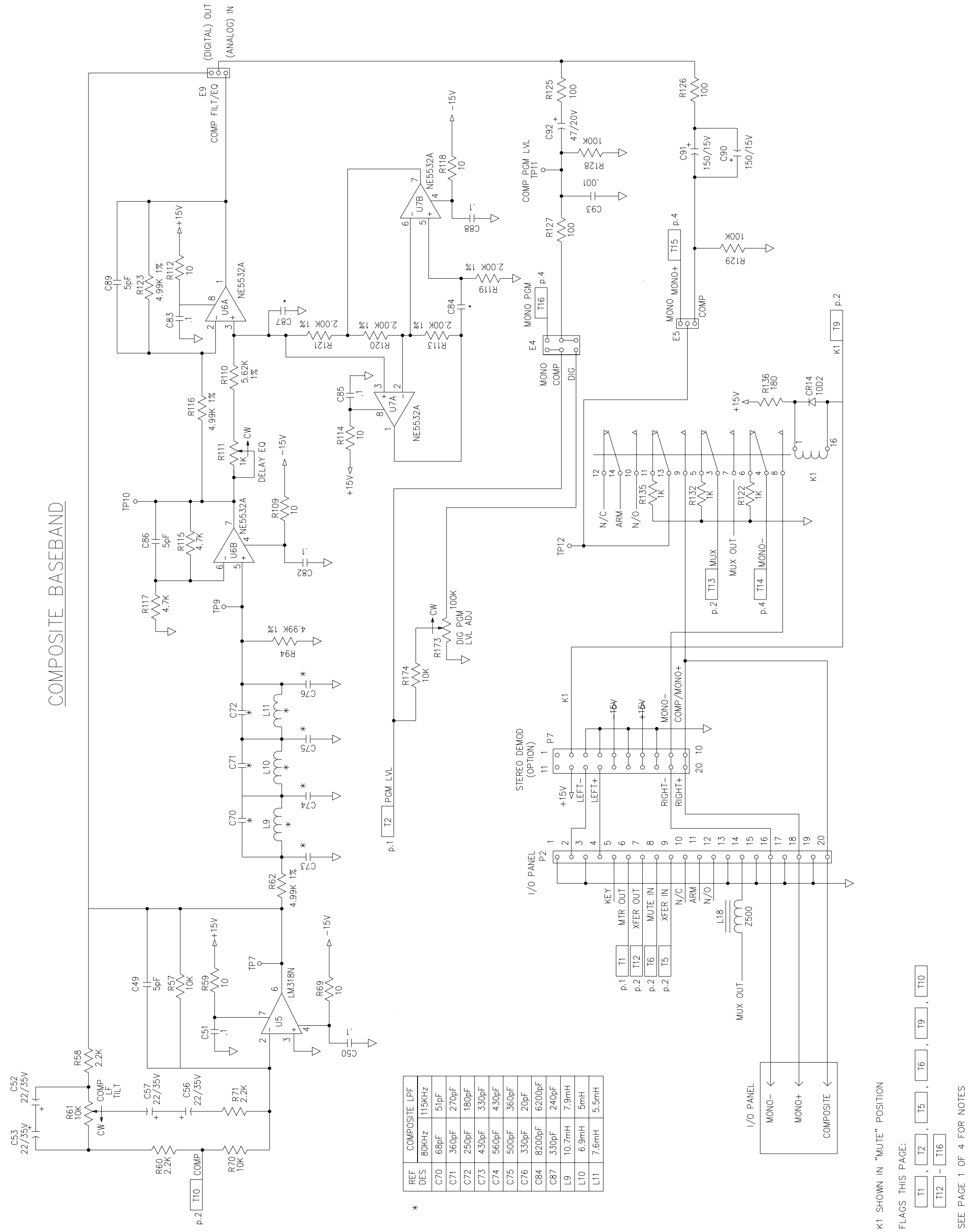
600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 1 of 4



600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 2 of 4

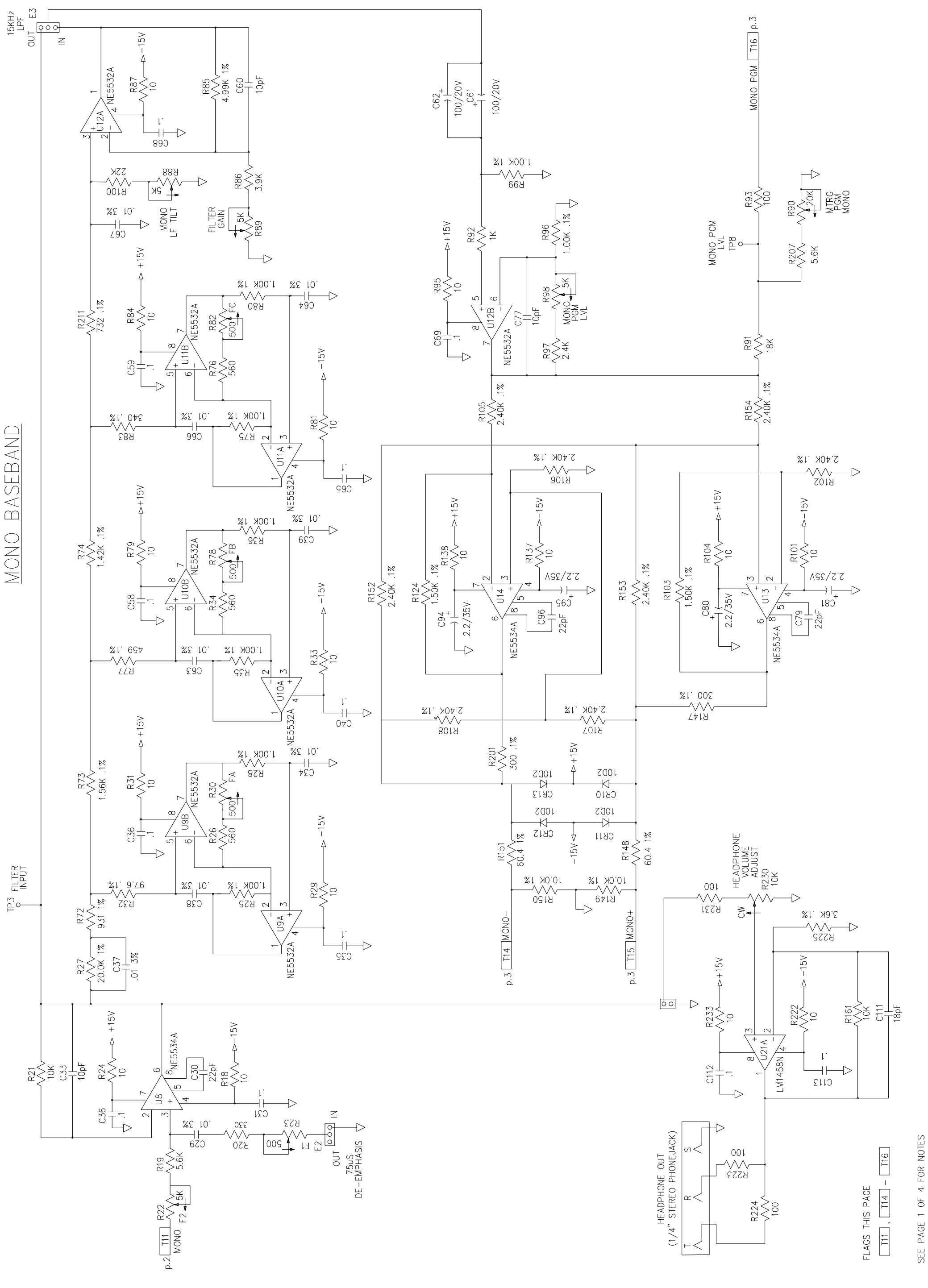


REF DES	COMPOSITE LPF 80KHz	COMPOSITE LPF 115KHz
C70	68pF	51pF
C71	360pF	270pF
C72	250pF	180pF
C73	430pF	330pF
C74	560pF	430pF
C75	500pF	360pF
C76	330pF	20pF
C84	8200pF	6200pF
C87	330pF	240pF
L9	10.7mH	7.9mH
L10	6.9mH	5mH
L11	7.6mH	5.5mH

*

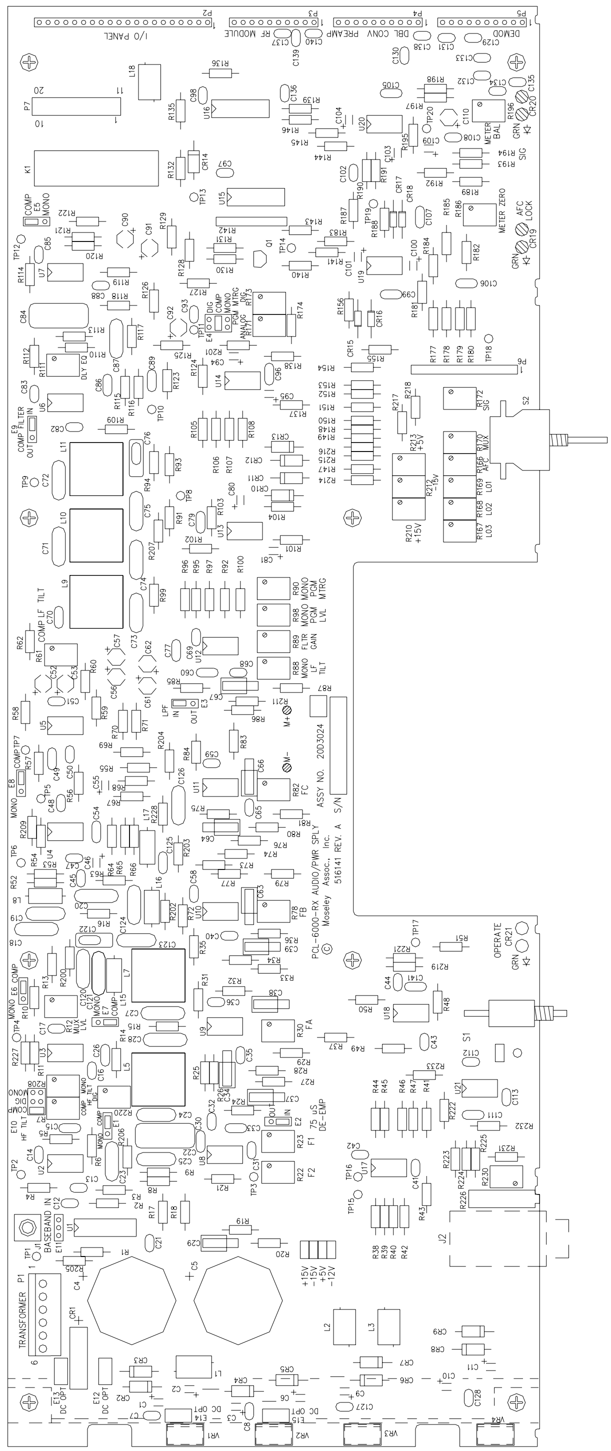
600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 3 of 4



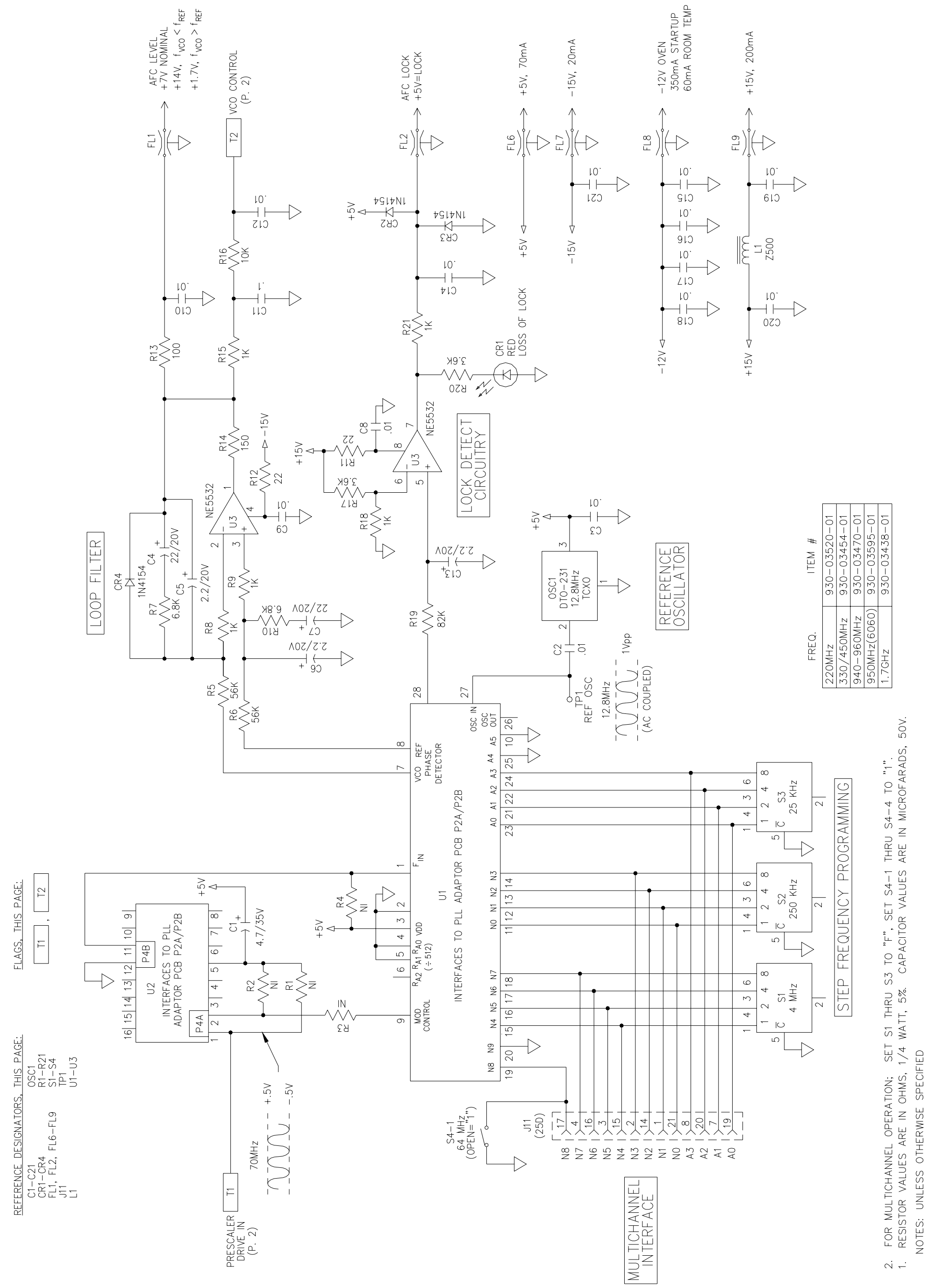
600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 4 of 4



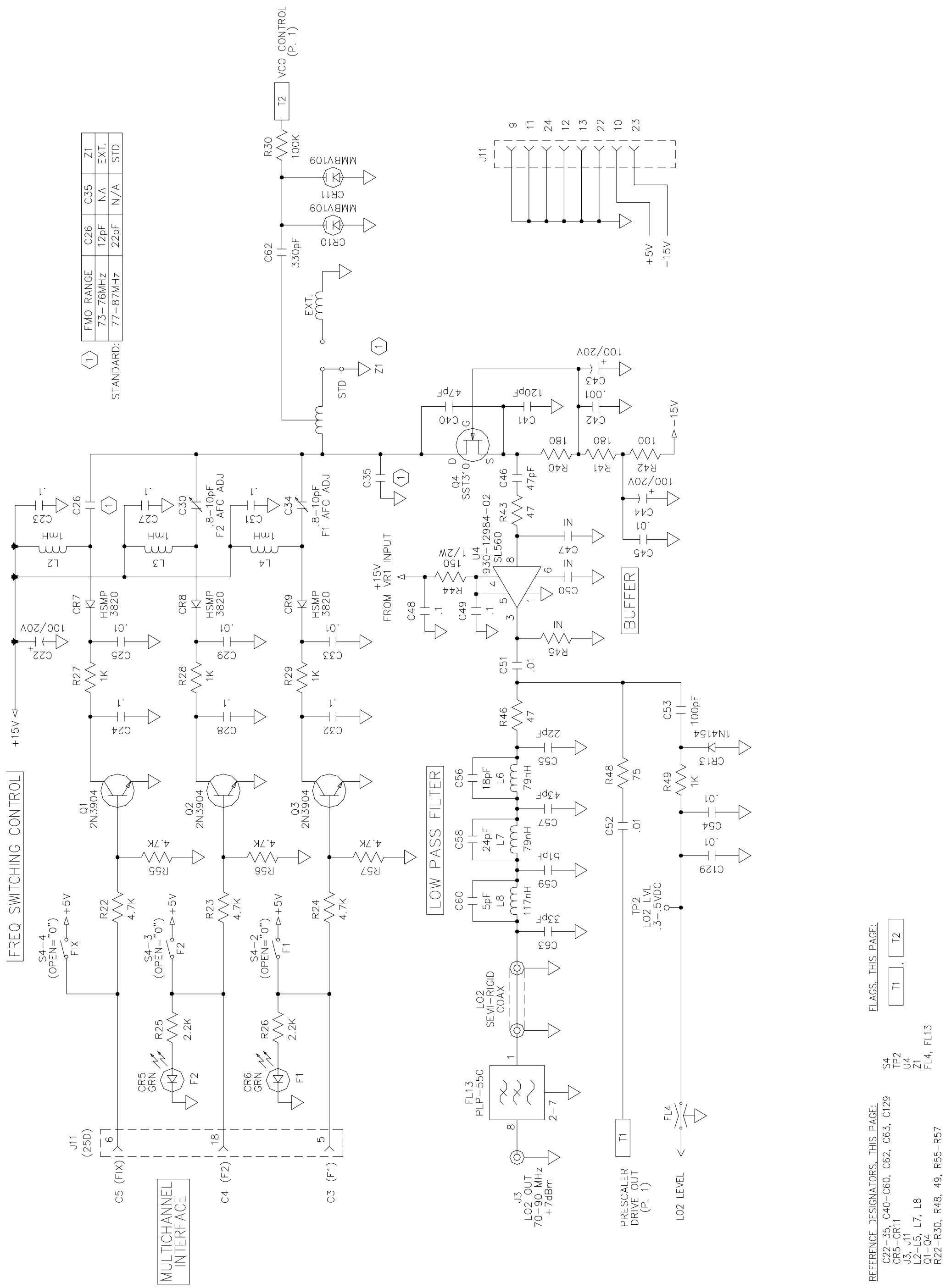
20B3024 Rev C

Receiver Audio/Power Supply Assembly

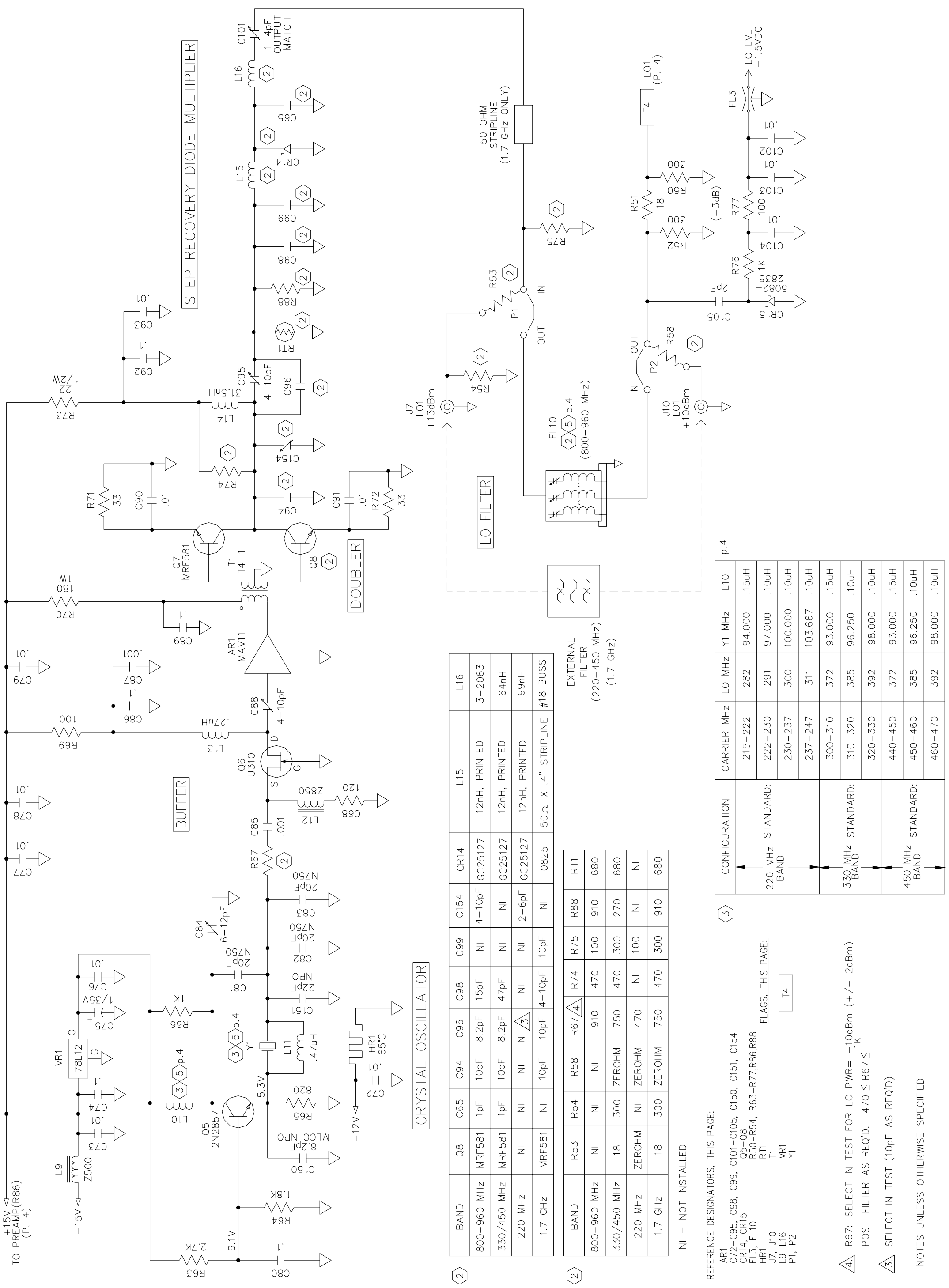


600-10228-01 Rev K

Receiver RF Module Schematic, p. 1 of 4

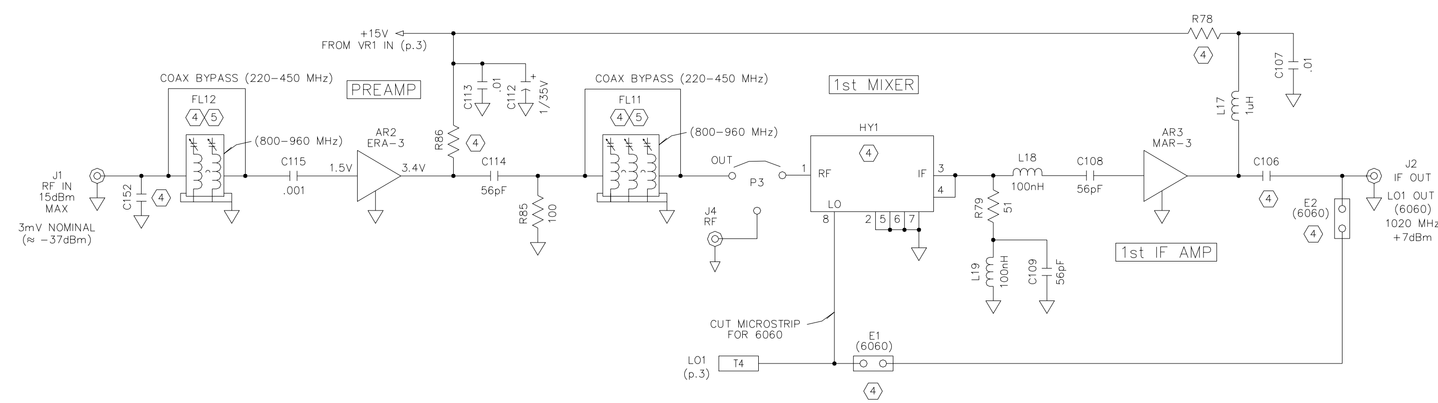


600-10228-01 Rev K
Receiver RF Module Schematic, p. 2 of 4



600-10228-01 Rev K

Receiver RF Module Schematic, p. 3 of 4



5

CONFIGURATION	CARRIER MHz	LO MHz	Y1 MHz (p.3)	L10 (p.3)	FL10 (p.3)	FL11 (4)	FL12 (4)
950 MHz BAND — STANDARD:	940–960	1020	102.000	.10uH	1271	1259	2737
	920–940	1000	100.000	.10uH	1271	1259	2737
	910–920	980	98.000	.10uH	1259	1259	2737
	900–910	980	98.000	.10uH	1259	1278	2737
	880–900	960	96.000	.10uH	1259	1278	2737
	860–880	940	94.000	.10uH	1259	1278	2737
	840–860	920	92.000	.10uH	1259	1328	2774
1.7 GHz BAND — STANDARD:	840–860	920	92.000	.10uH	1259	1328	2774
	820–840	900	90.000	.10uH	1278	1328	2774
	800–820	880	88.000	.10uH	1278	1328	2774
	780–800	860	86.000	.15uH	—	—	—
	760–780	840	84.000	.15uH	—	—	—
	740–760	820	82.000	.15uH	—	—	—

4

BAND	HY1	R86	R78	C106	FL12 / FL11	E1	E2	C152
6020/6030 950 MHz	SRA12	360	360	.01	(SEE CONFIG CHART) 5	NI	NI	1.0pF
6060 950 MHz	N/A	NI	NI	NI	NA	JUMPER	JUMPER	1.0pF
330/450 MHz	RFMX1	360	360	.01	COAX BYPASS	NI	NI	NI
220 MHz	RFMX1	360	360	.01	COAX BYPASS	NI	NI	NI
1.7GHz	RFMX1	360	360	.01	COAX BYPASS	NI	NI	NI

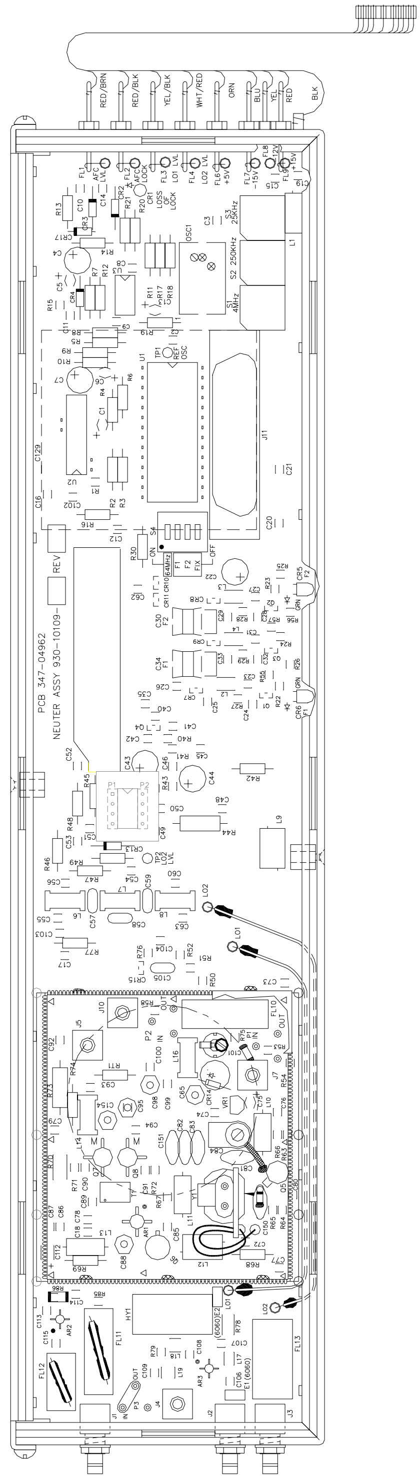
NI = NOT INSTALLED

REFERENCE DESIGNATORS, THIS PAGE:
AR2,AR3
C106–C109, C112–C115, C152
E1, E2
FL11, FL12
HY1
J1, J2, J4
L17–L19
P3
R78, R79, R85, R86
Z2

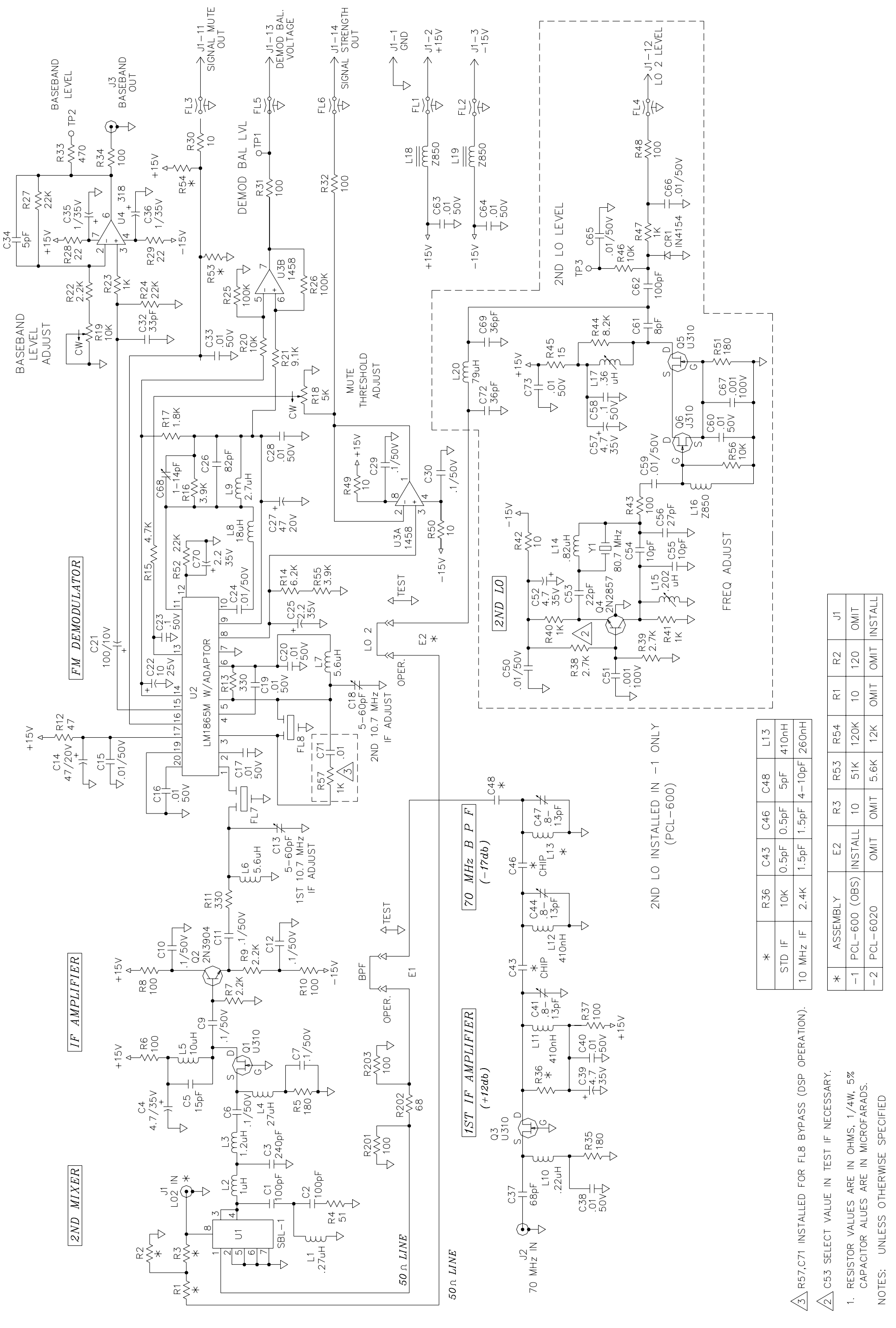
FLAGS, THIS PAGE:
T4

600-10228-01 Rev K

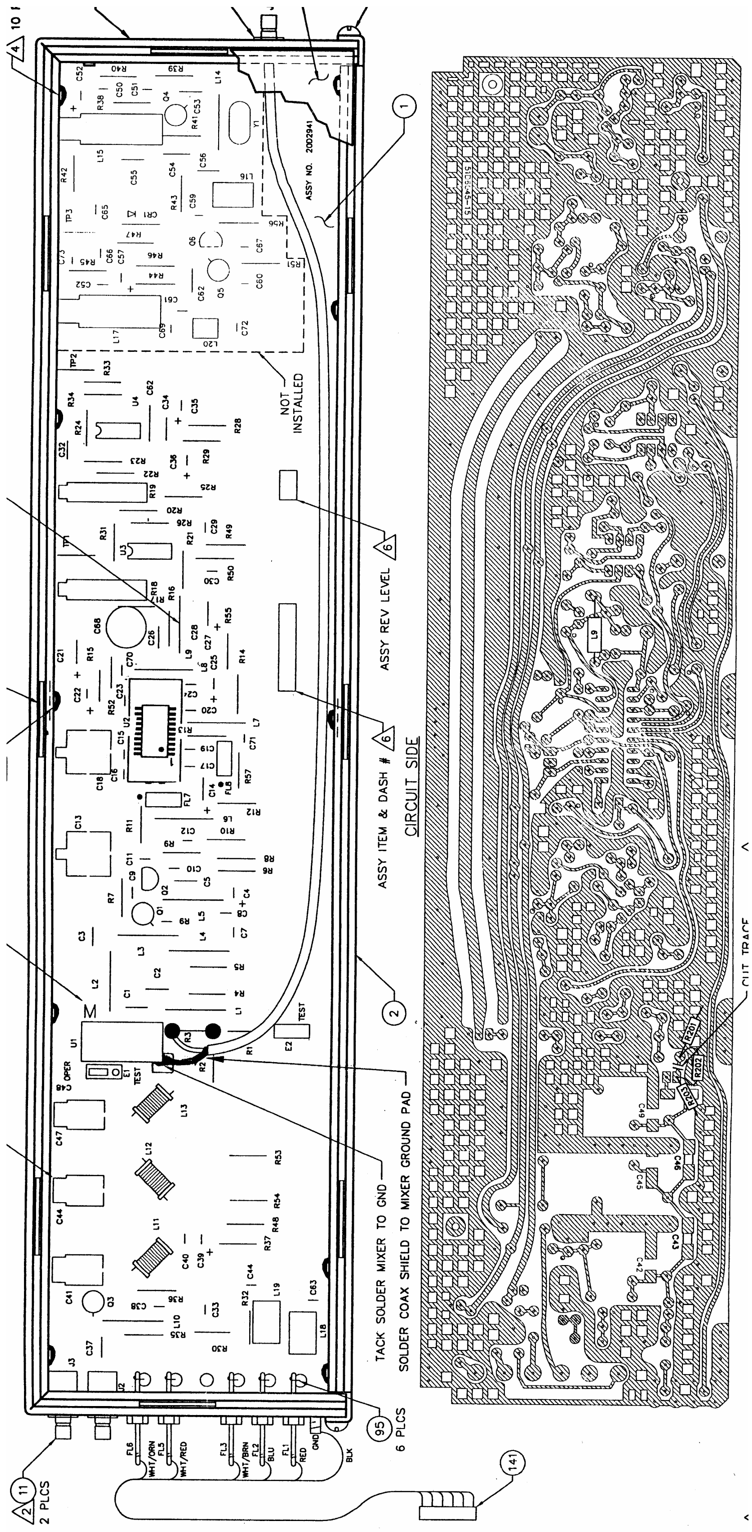
Receiver RF Module Schematic, p. 4 of 4



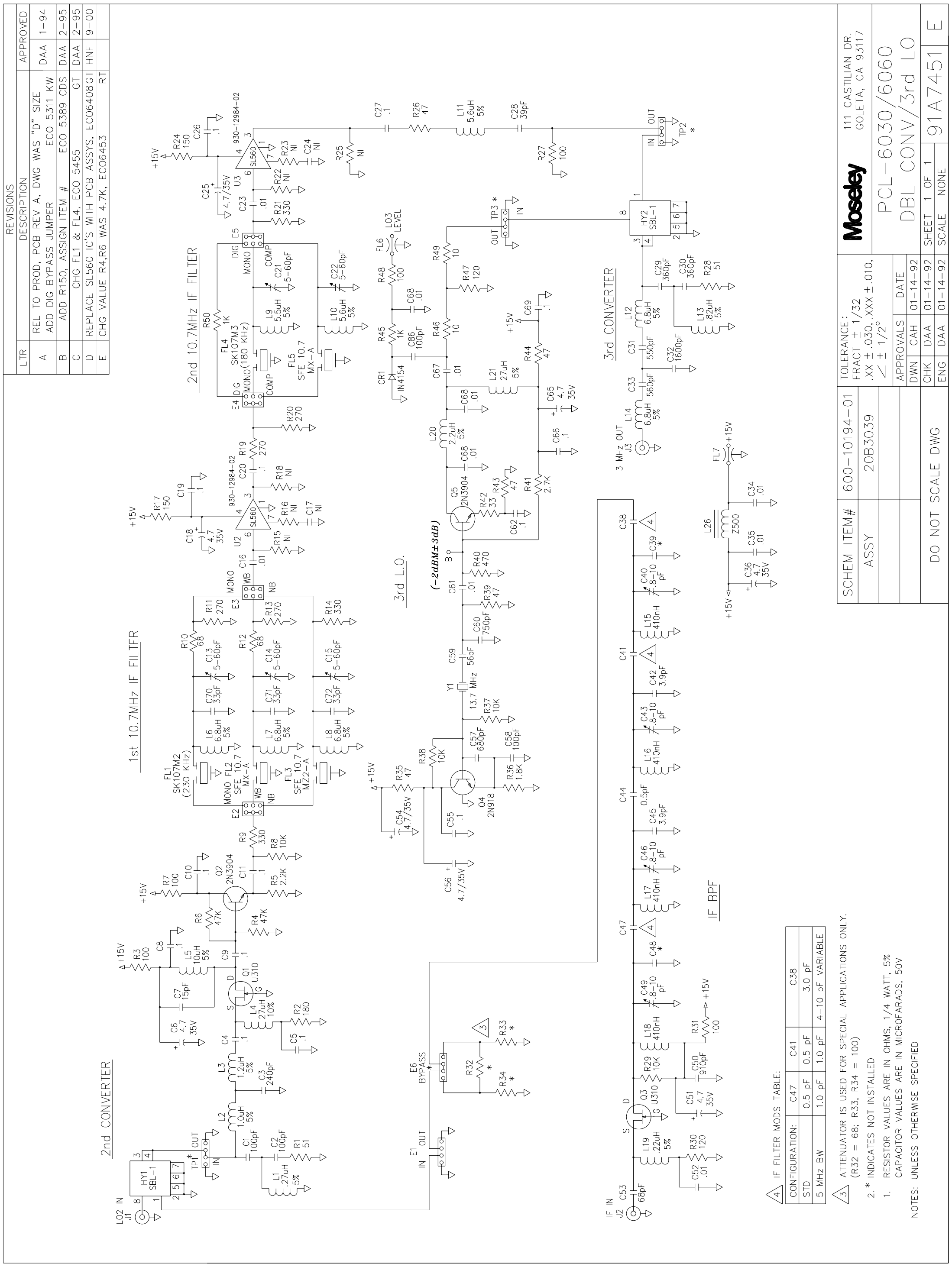
930-03454-01_J330_450_RX_RF
Receiver RF Module (6030) Assembly



91B7375 Rev C
IF Demod (6020) Schematic

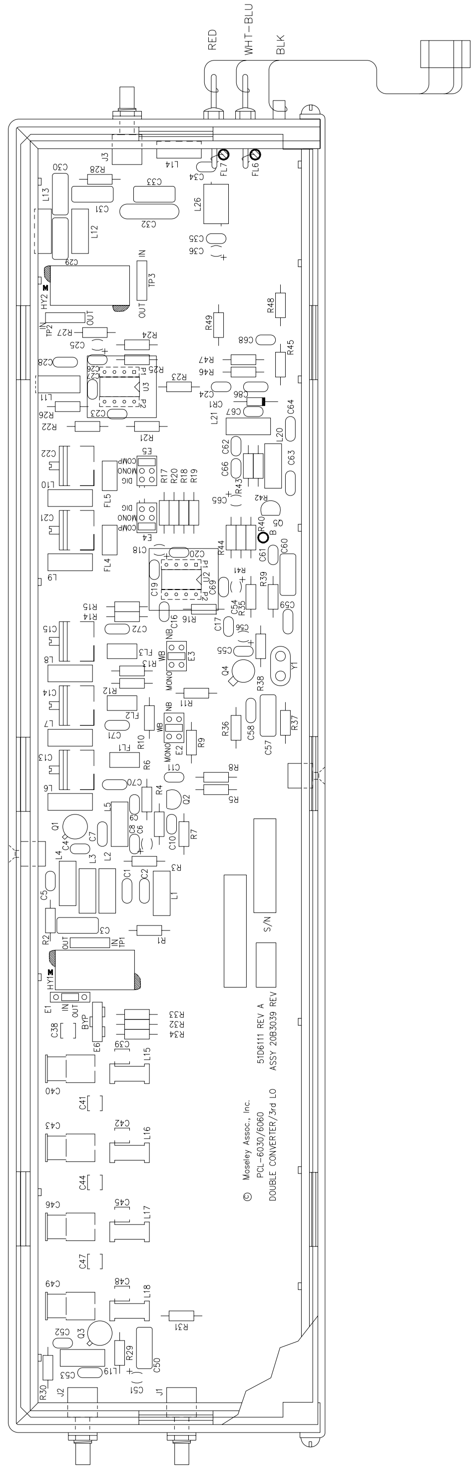


20B2941-2 Rev C
IF DEMOD (6020) Assembly

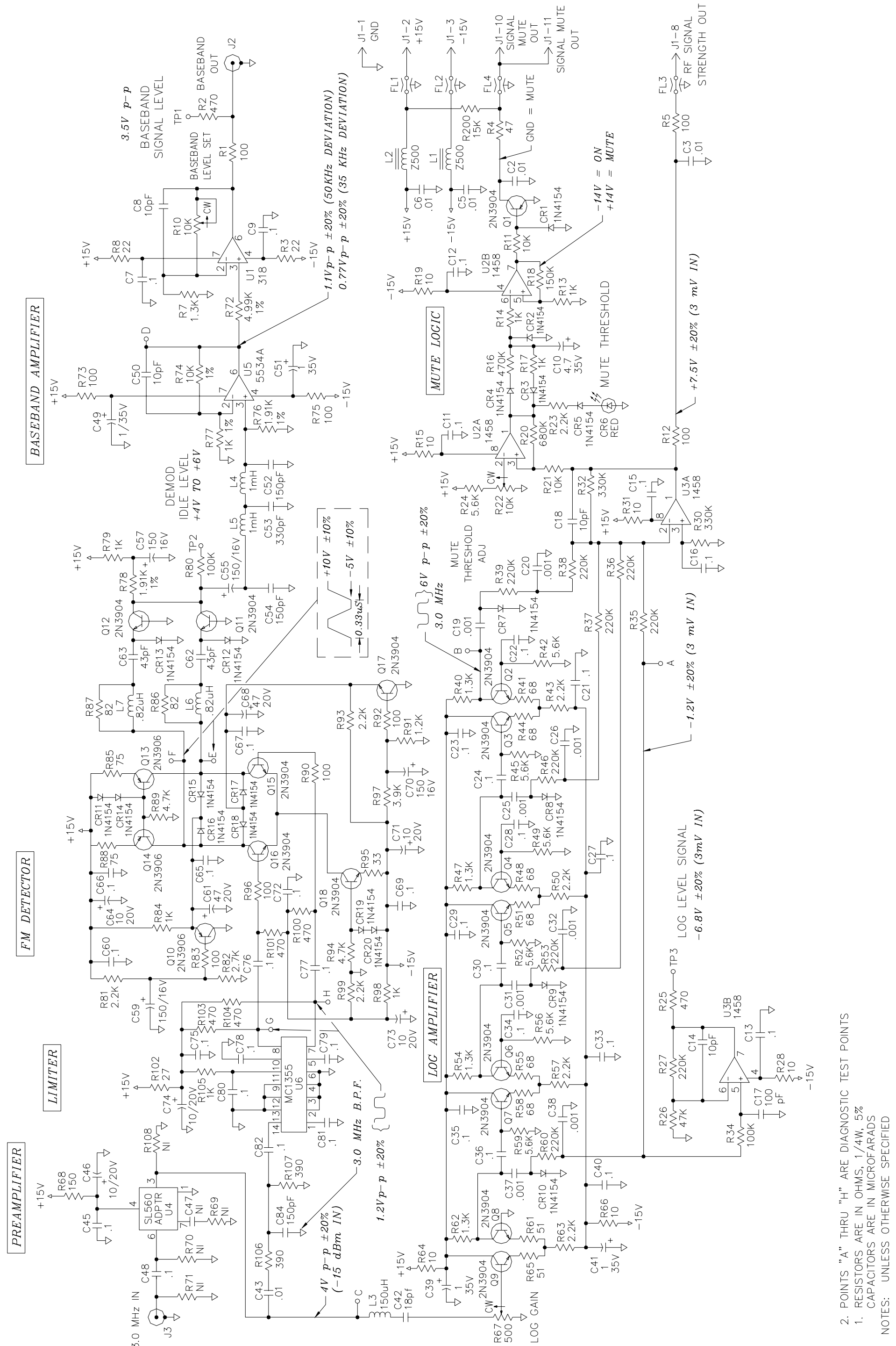


91B7451 Rev E

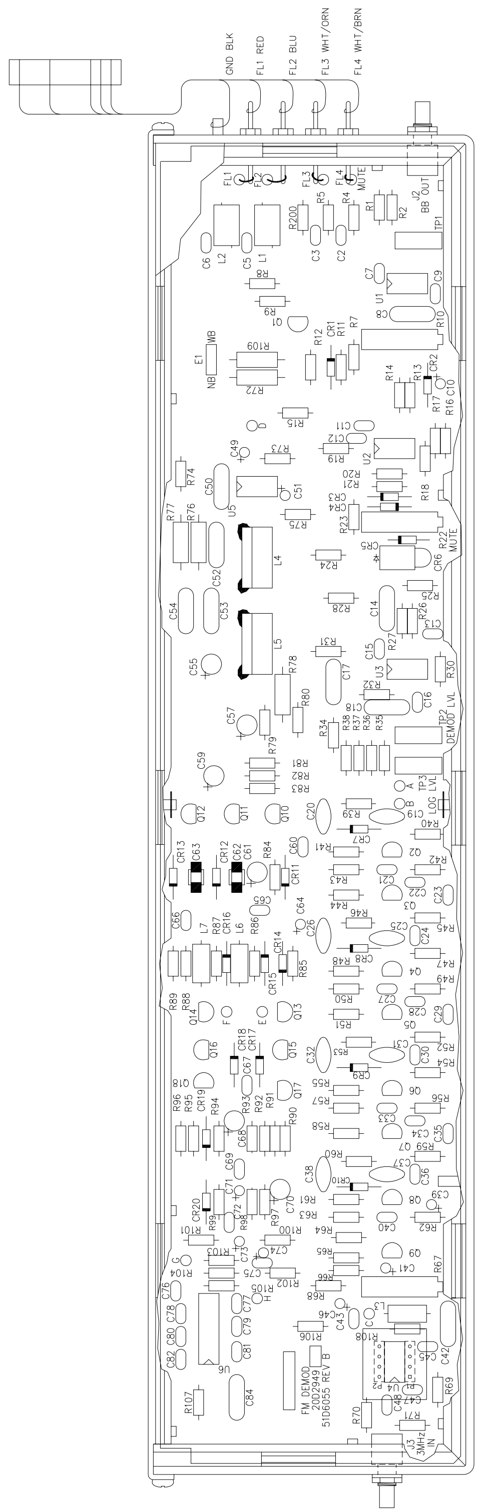
Double Converter/LO3 (6030) Schematic



20B3039 Rev E
Double Converter/LO3 (6030) Assembly



91B7387 Rev F
FM Demod (6030) Schematic



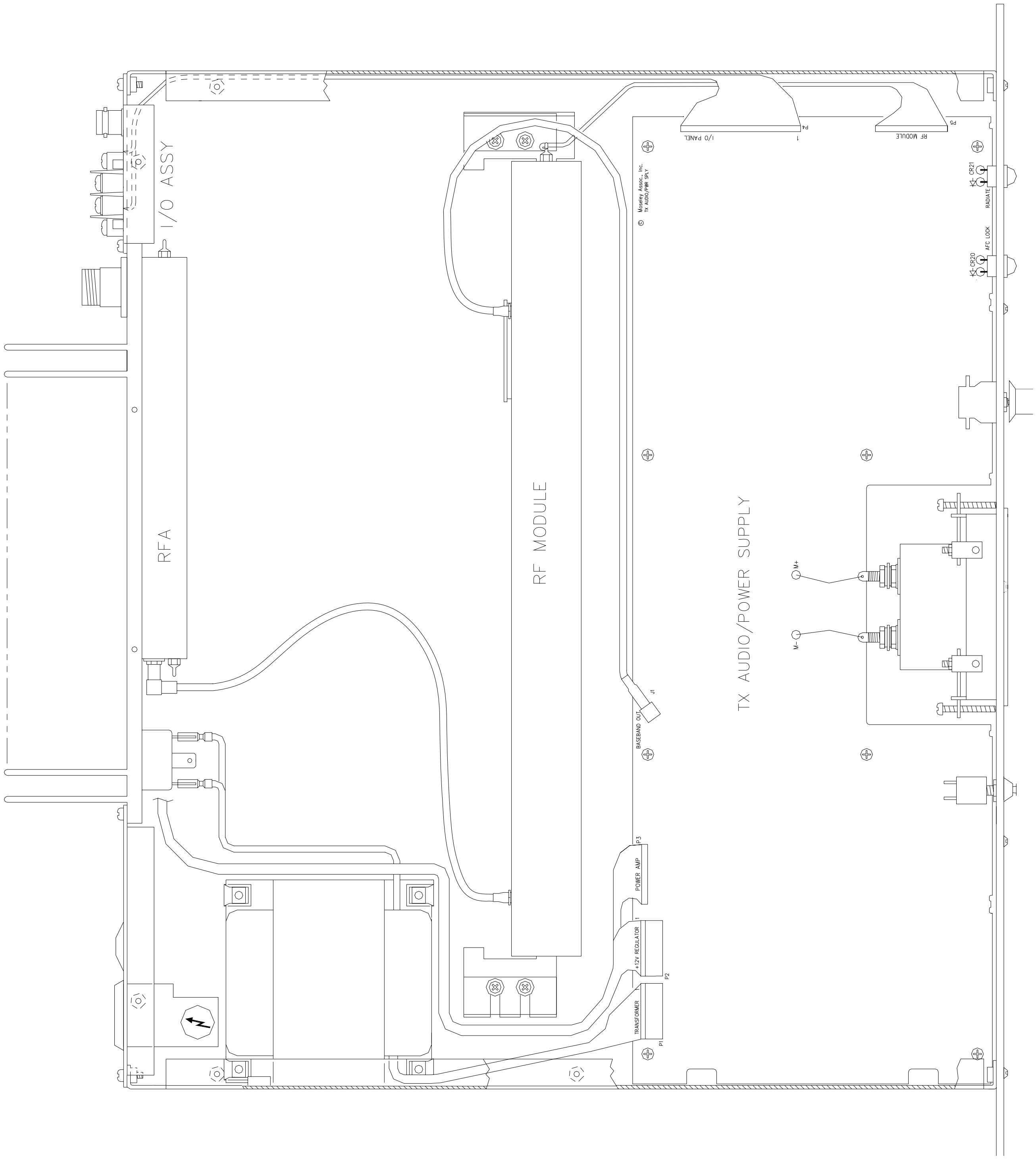
20B2949 Rev G
FM Demod (6030) Assembly

7.3 PCL 6000 950 MHz STD

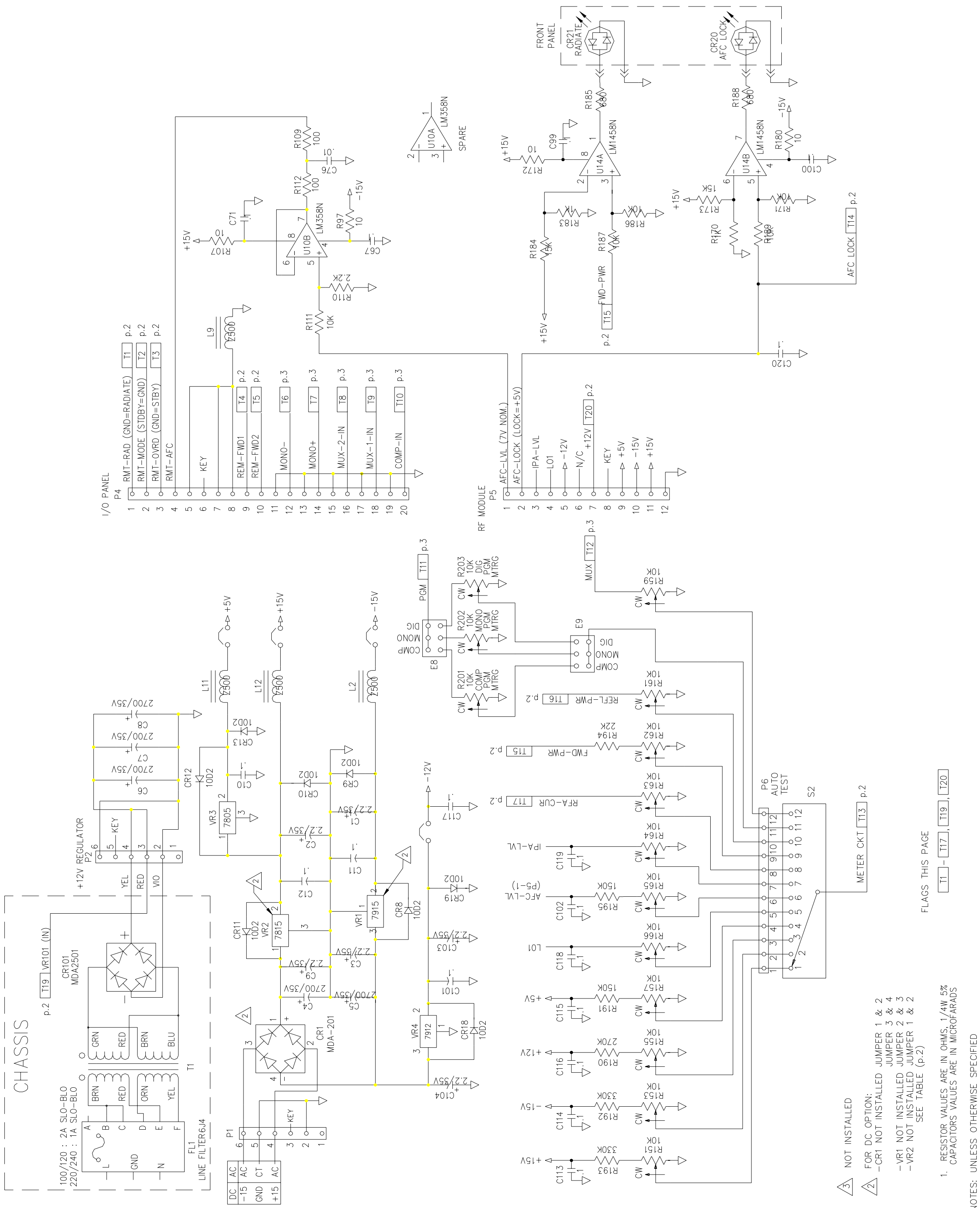
DESCRIPTION	ENG. DWG. No.	REV LEVEL
Transmitter Final Assembly	21B2890-1	G
Transmitter Audio/Power Supply Schematic	91B7444	D
Transmitter Audio/Power Supply Assembly	20B3023	D
Transmitter RF Module Schematic	600-10227-01	H
Transmitter RF Module Assembly	930-03462-01	H
RF Amplifier Schematic	91B7379	C
RF Amplifier Assembly	930-02936-03	T
6020 Receiver Final Assembly	21B2891-1	D
6030 Receiver Final Assembly	21B2892-1	D
6060 Receiver Final Assembly	21B2915	D
Receiver Audio/Power Supply Schematic	600-10710-01	B
Receiver Audio/Power Supply Assembly	20B3024	C
Receiver RF Module Schematic	600-10228-01	K
Receiver RF Module (6020/6030) Assembly	930-03470-01	J
Receiver RF Module (6060) Assembly	930-03595-01	J
Preamp/1st Mixer (6060) Schematic	91D7274-2	J
Preamp/1st Mixer (6060) Assembly	20D2827	P1
IF Demod (6020) Schematic	91B7375	C
IF Demod (6020) Assembly	20B2941	C
Double Converter/LO3 (6030/6060) Schematic	91B7451	E
Double Converter/LO3 (6030/6060) Assembly	20B3039	E
FM Demod (6030/6060) Schematic	91B7387	F
FM Demod (6030/6060) Assembly	20B2949	G
Adjacent Channel Filter (6060) Schematic	91B7502	1
Adjacent Channel Filter (6060) Assembly	20B3089	1

NOTICE:

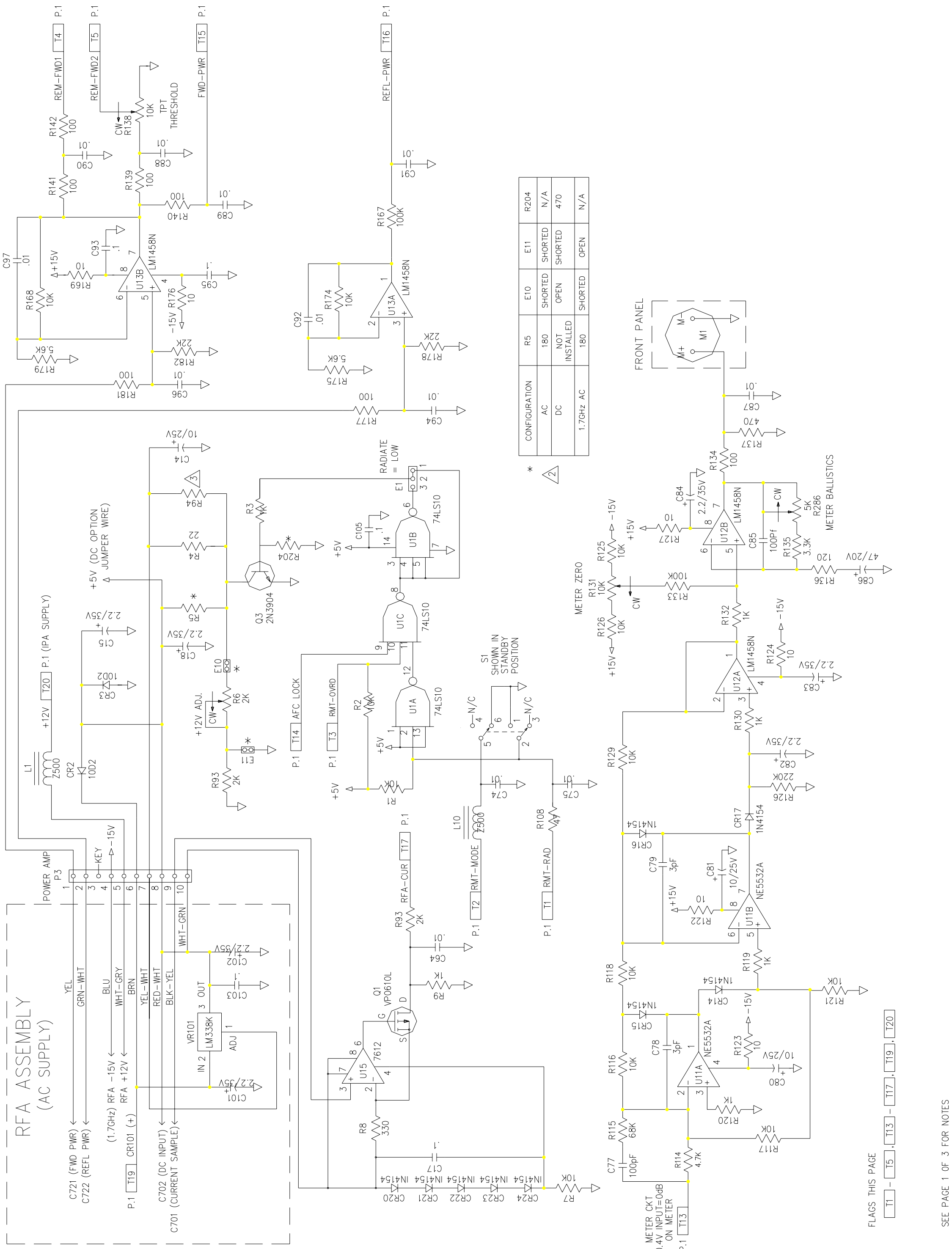
This section contains schematic and assembly drawings referred to in Sections 1 and 4. For information on individual drawings refer to Section 1 under "System Description" and/or Section 4 under "Module Description".



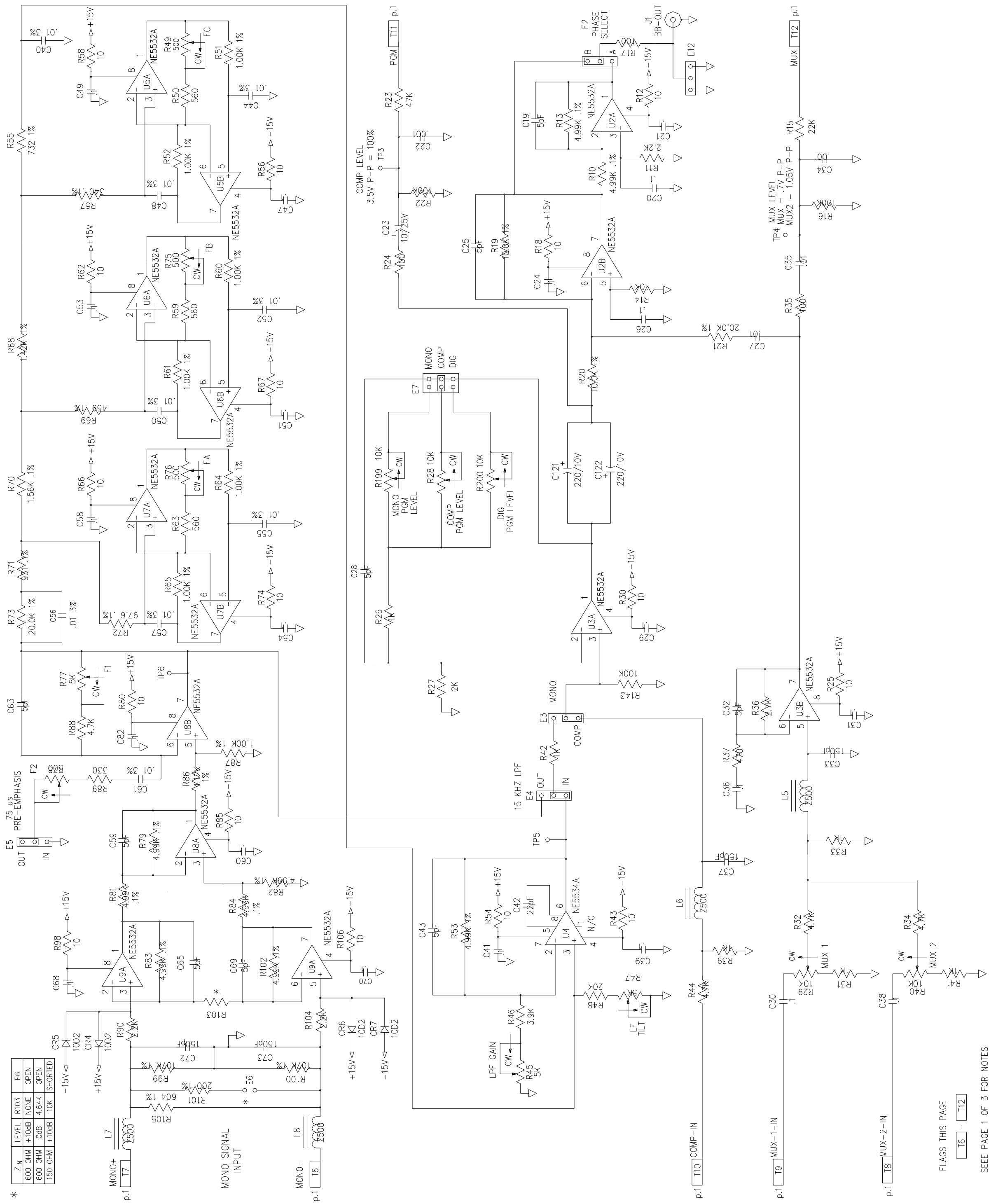
21D2890-1 Rev G
6010 Transmitter Final Assembly (950 MHz)



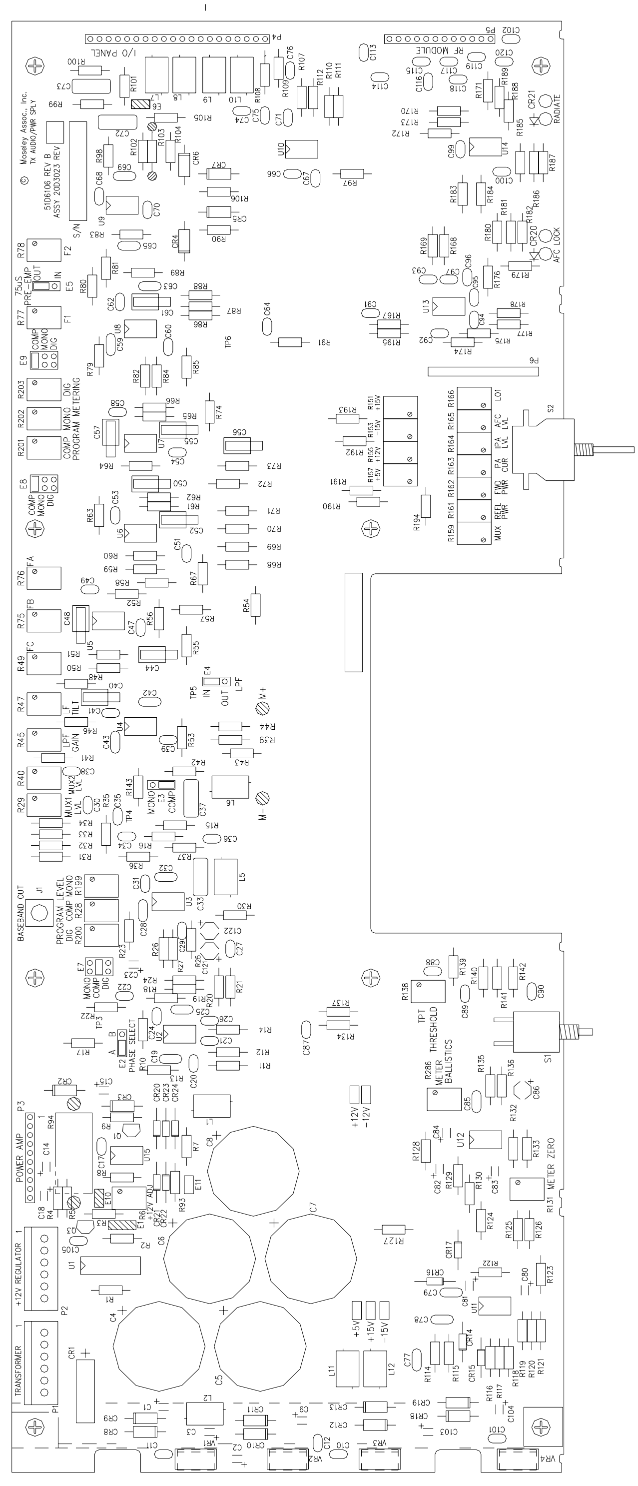
91B7444 Rev D
Transmitter Audio/Power Supply Schematic, p. 1 of 3



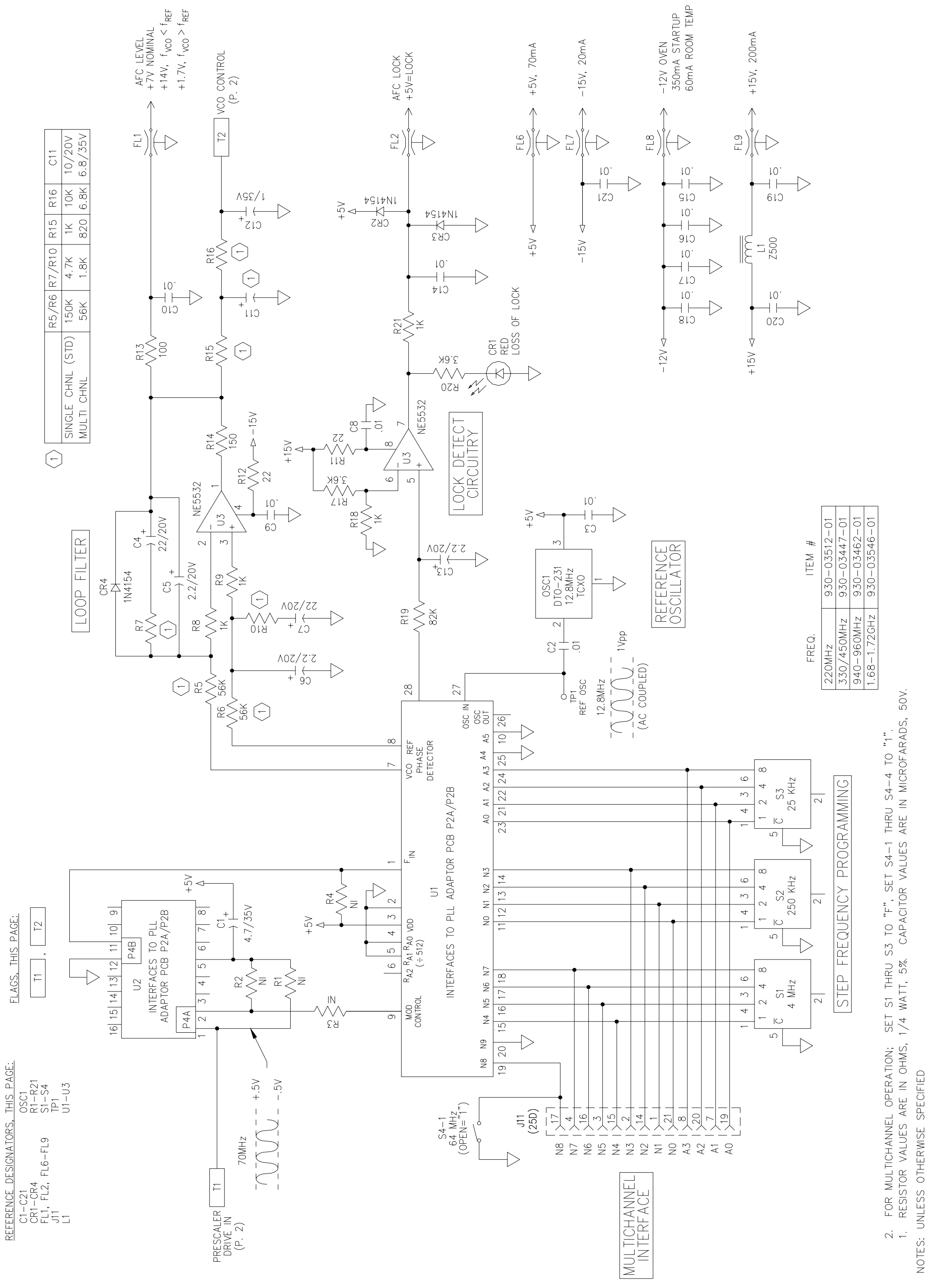
91B7444 Rev D
Transmitter Audio/Power Supply Schematic, p. 2 of 3



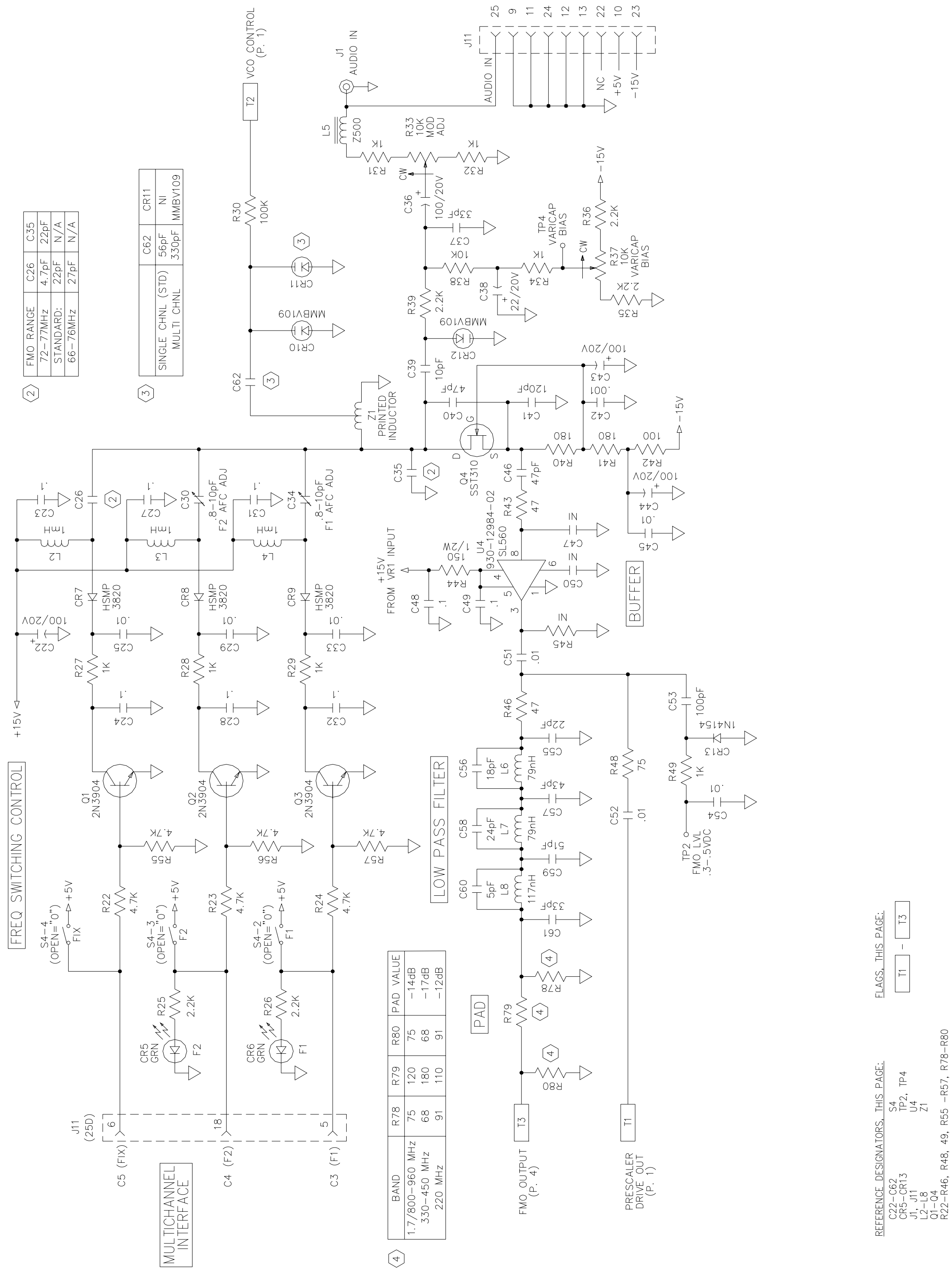
91B7444 Rev D
Transmitter Audio/Power Supply Schematic, p. 3 of 3



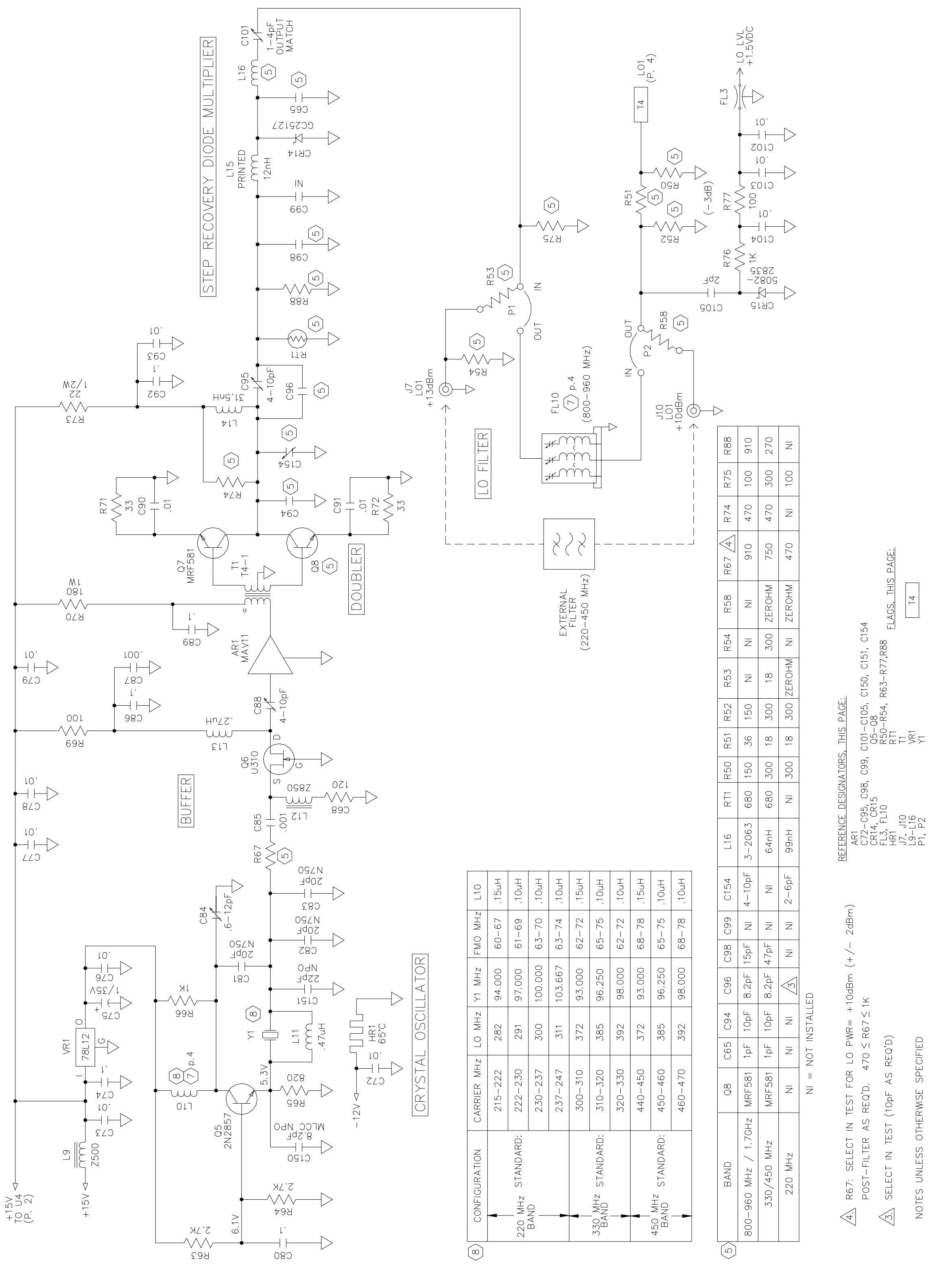
20B3023 Rev D
Transmitter Audio/Power Supply Assembly



600-10227-01 REV H
Transmitter RF Module Schematic, p. 1 of 4



600-10227-01 REV H
Transmitter RF Module Schematic, p. 2 of 4



CONFIGURATION	CARRIER MHz	LO MHz	Y1 MHz	FMO MHz	L10
220 MHz BAND STANDARD:	215–222	282	94.000	60–67	.15uH
	222–230	291	97.000	61–69	.10uH
	230–237	300	100.000	63–70	.10uH
	237–247	311	103.667	63–74	.10uH
330 MHz BAND STANDARD:	300–310	372	93.000	62–72	.15uH
	310–320	385	96.250	65–75	.10uH
	320–330	392	98.000	62–72	.10uH
450 MHz BAND STANDARD:	440–450	372	93.000	68–78	.15uH
	450–460	385	96.250	65–75	.10uH
	460–470	392	98.000	68–78	.10uH

BAND	Q8	C65	C94	C96	C98	C99	C154	L16	RT1	R50	R51	R52	R53	R54	R58	R67 (4)	R74	R75	R88
800–960 MHz / 1.7GHz	MRF581	1pF	10pF	8.2pF	15pF	NI	4–10pF	3–2063	680	150	36	150	NI	NI	NI	910	470	100	910
330/450 MHz	MRF581	1pF	10pF	8.2pF	47pF	NI	NI	64nH	680	300	18	300	18	300	ZEROHM	750	470	300	270
220 MHz	NI	NI	NI	(3)	NI	NI	2–6pF	99nH	NI	300	18	300	ZEROHM	NI	ZEROHM	470	NI	100	NI

NI = NOT INSTALLED

(4) R67: SELECT IN TEST FOR LO PWR= +10dBm (+/- 2dBm) POST-FILTER AS REQ'D. 470 ≤ R67 ≤ 1K

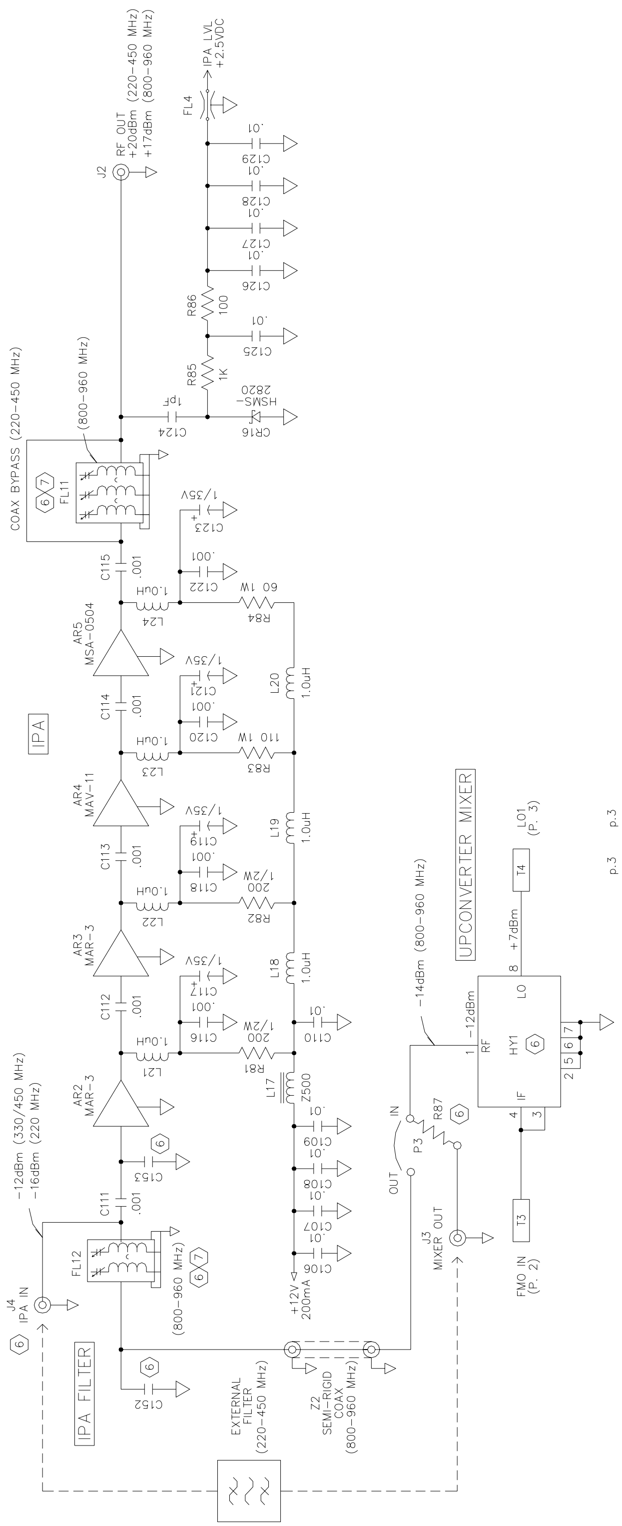
(3) SELECT IN TEST (10pF AS REQ'D)

NOTES UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATORS, THIS PAGE:
AR1
C72–C95, C98, C99, C101–C105, C150, C151, C154
CR14, CR15
FL3, FL10
HR1
J7, J10
L9–L16
P1, P2
Q5–Q8
R50–R54, R63–R77, R88
RT1
T1
VR1
Y1

FLAGS, THIS PAGE: T4

600-10227-01 REV H
Transmitter RF Module Schematic, p. 3 of 4



Note 7:

CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz	FMO MHz	L10 (p.3)	FL10 (p.3)	FL11	FL12
950 MHz BAND	STANDARD:	940-960	1020	102.000	60-80	.10uH	1271	1259	2737
950 MHz BAND		920-940	1000	100.000	60-80	.10uH	1271	1259	2737
950 MHz BAND		910-920	980	98.000	60-80	.10uH	1259	1259	2737
950 MHz BAND		900-910	980	98.000	60-80	.10uH	1259	1278	2737
950 MHz BAND		880-900	960	96.000	60-80	.15uH	1259	1278	2737
950 MHz BAND		860-880	940	94.000	60-80	.15uH	1259	1278	2737
950 MHz BAND		840-860	920	92.000	60-80	.15uH	1259	1328	2774
950 MHz BAND / 1.7 GHz BAND	1.68-1.72 GHz	840-860	920	92.000	60-80	.15uH	1259	1328	2774
950 MHz BAND / 1.7 GHz BAND	1.64-1.68 GHz	820-840	900	90.000	60-80	.15uH	1278	1328	2774
1.7 GHz BAND	1.60-1.64 GHz	800-820	880	88.000	60-80	.15uH	1278	1328	2774
1.7 GHz BAND	1.56-1.60 GHz	780-800	860	86.000	60-80	.15uH	—	—	—
1.7 GHz BAND	1.52-1.56 GHz	760-780	840	84.000	60-80	.15uH	—	—	—
1.7 GHz BAND	1.48-1.52 GHz	740-760	820	82.000	60-80	.15uH	—	—	—

NOTE: CRYSTALS AND FILTERS ARE INSTALLED IN TEST PER CUSTOMER FREQUENCY.

Note 6:

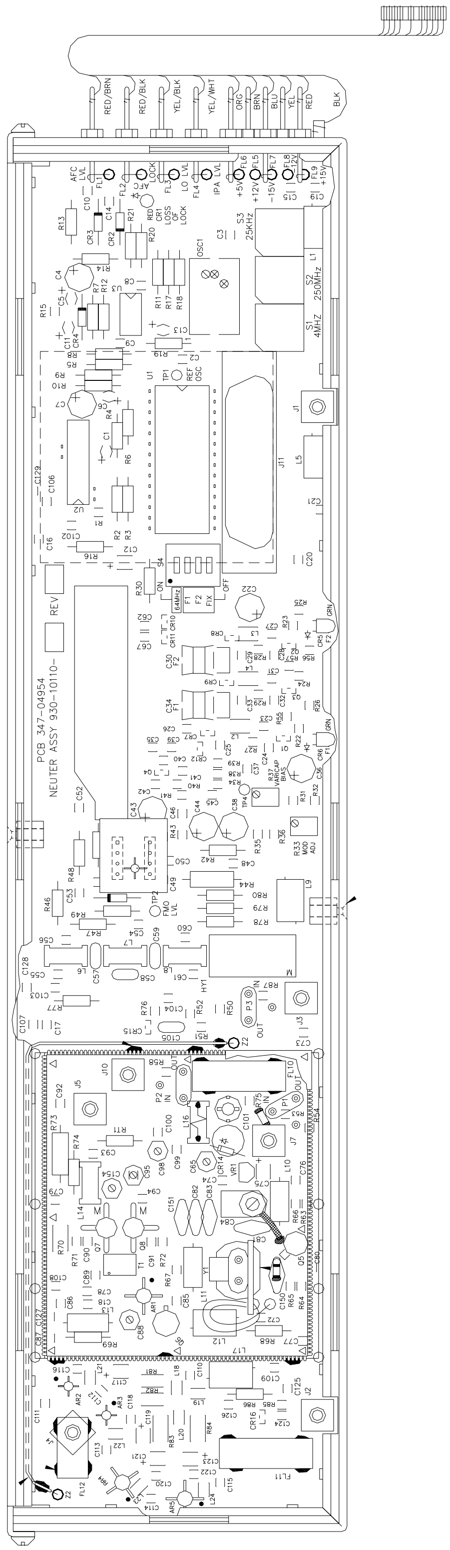
BAND	R87	FL12	FL11	J4	HY1	C152	C153
1.7/800-960 MHz	NI	(SEE CONFIG CHART) 7		NI	SRA-12	1.0pF	2.2pF
330/450 MHz	ZEROHM	NI	COAX BYPASS	SMB VERT.	RFMX-1	NI	NI
220 MHz	ZEROHM	NI	COAX BYPASS	SMB VERT.	RFMX-1	NI	NI

NI = NOT INSTALLED

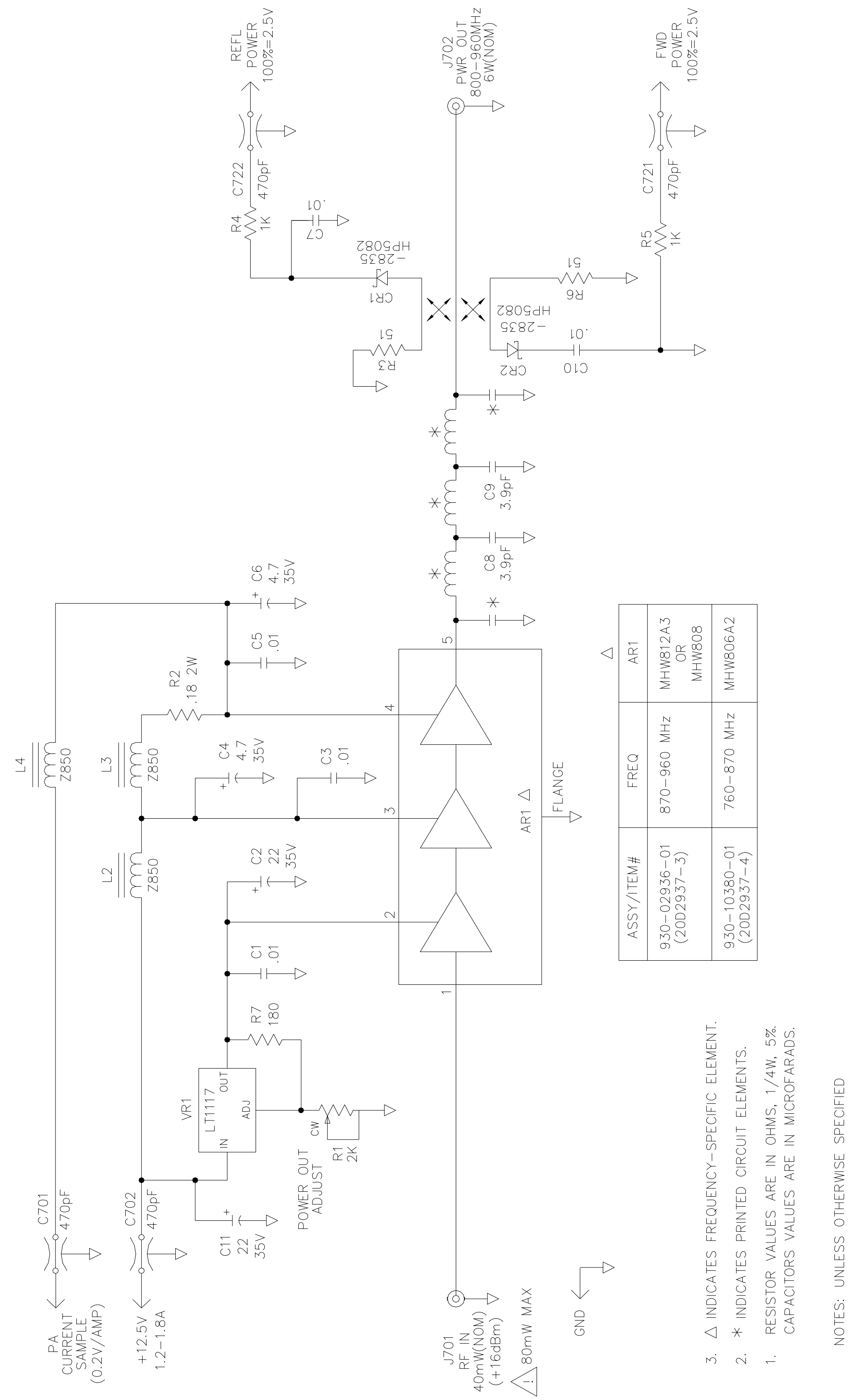
REFERENCE DESIGNATORS, THIS PAGE:
AR2-AR5
C106-C129, C152, C153
CR16
FL4, FL11, FL12
HY1
J2-J4
L17-24
P3
R81-R87
Z2

FLAGS, THIS PAGE:
T3 , T4

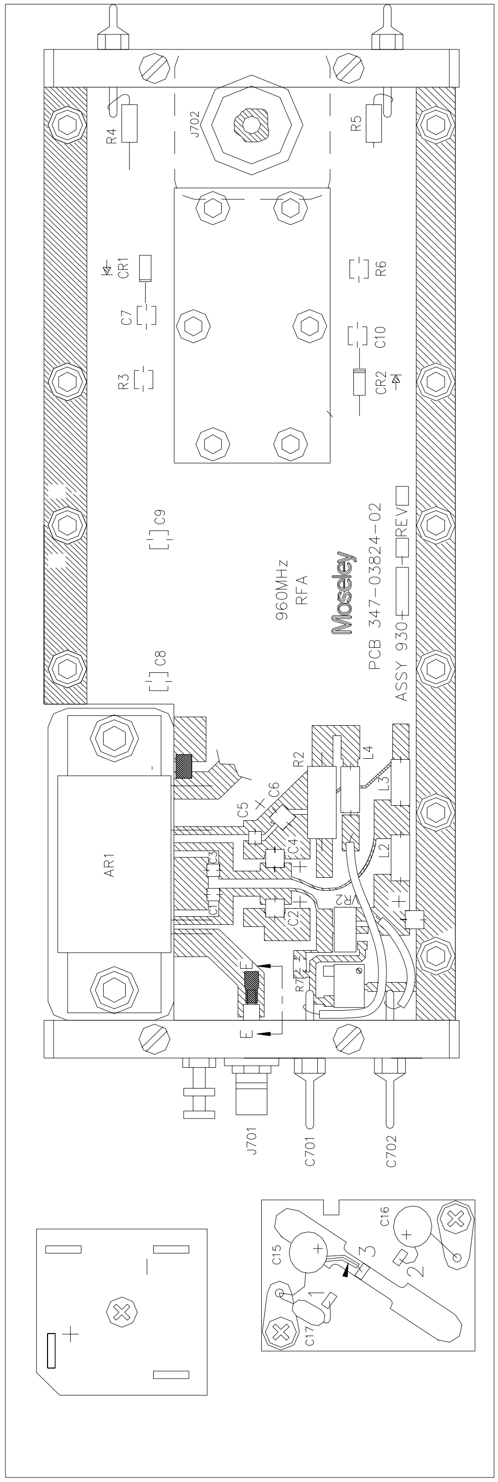
600-10227-01 REV H
Transmitter RF Module Schematic, p. 4 of 4



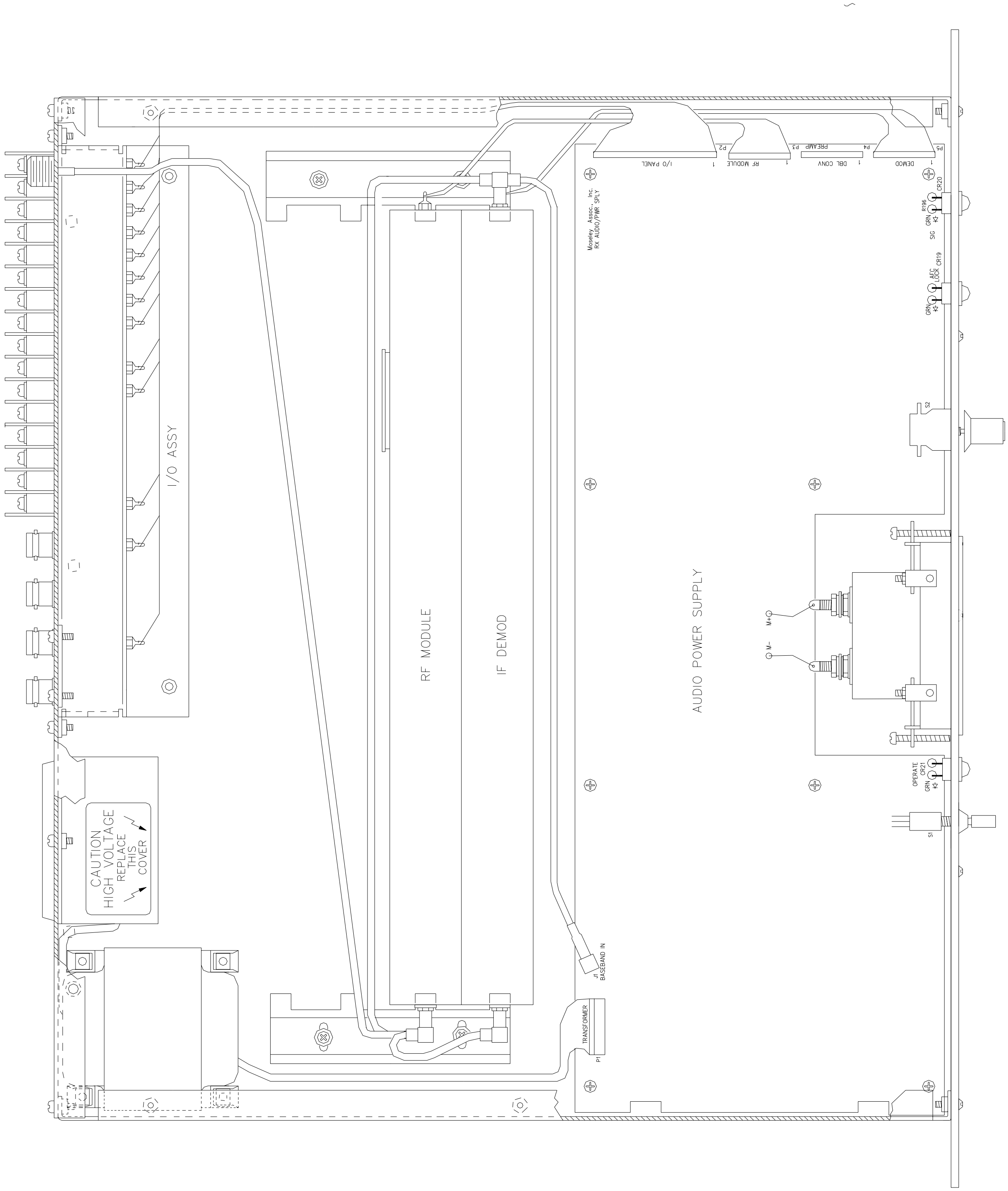
930-03462-01 Rev H
Transmitter RF Module Assembly



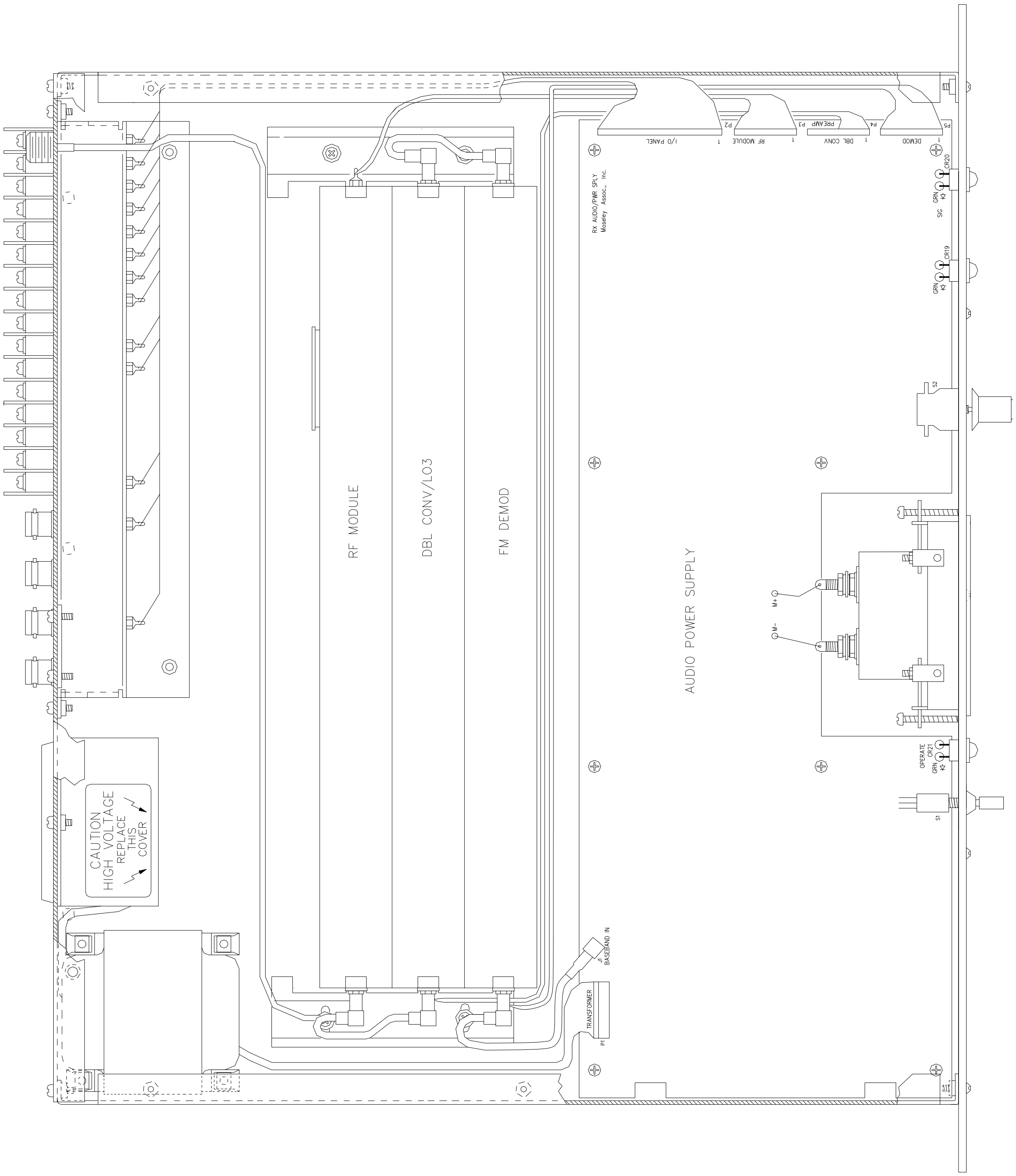
91B7379 Rev C
RF Amplifier (950 MHz, 6w) Schematic



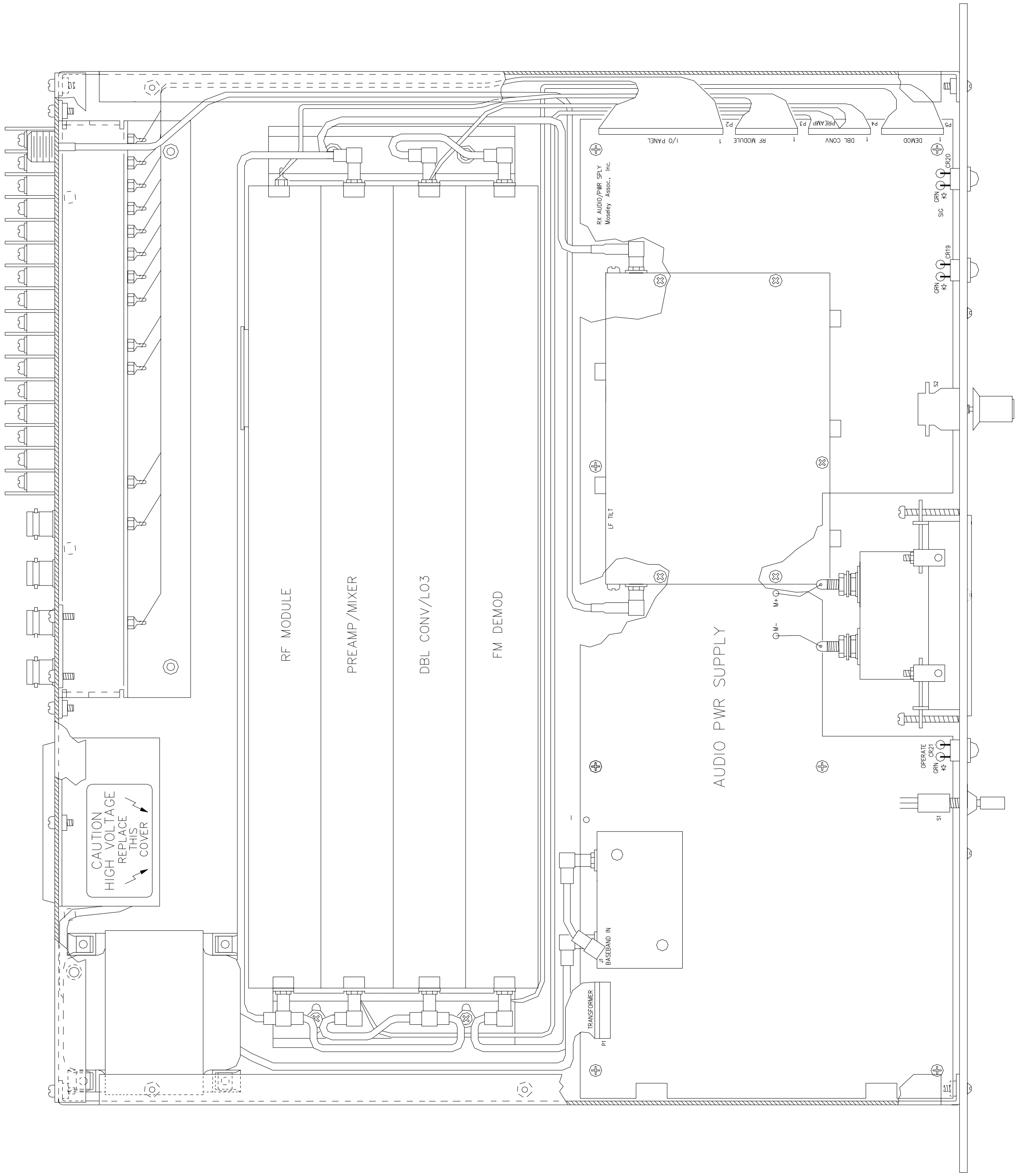
930-02936-03 Rev T
RF Amplifier (950 MHz,6w) Assembly



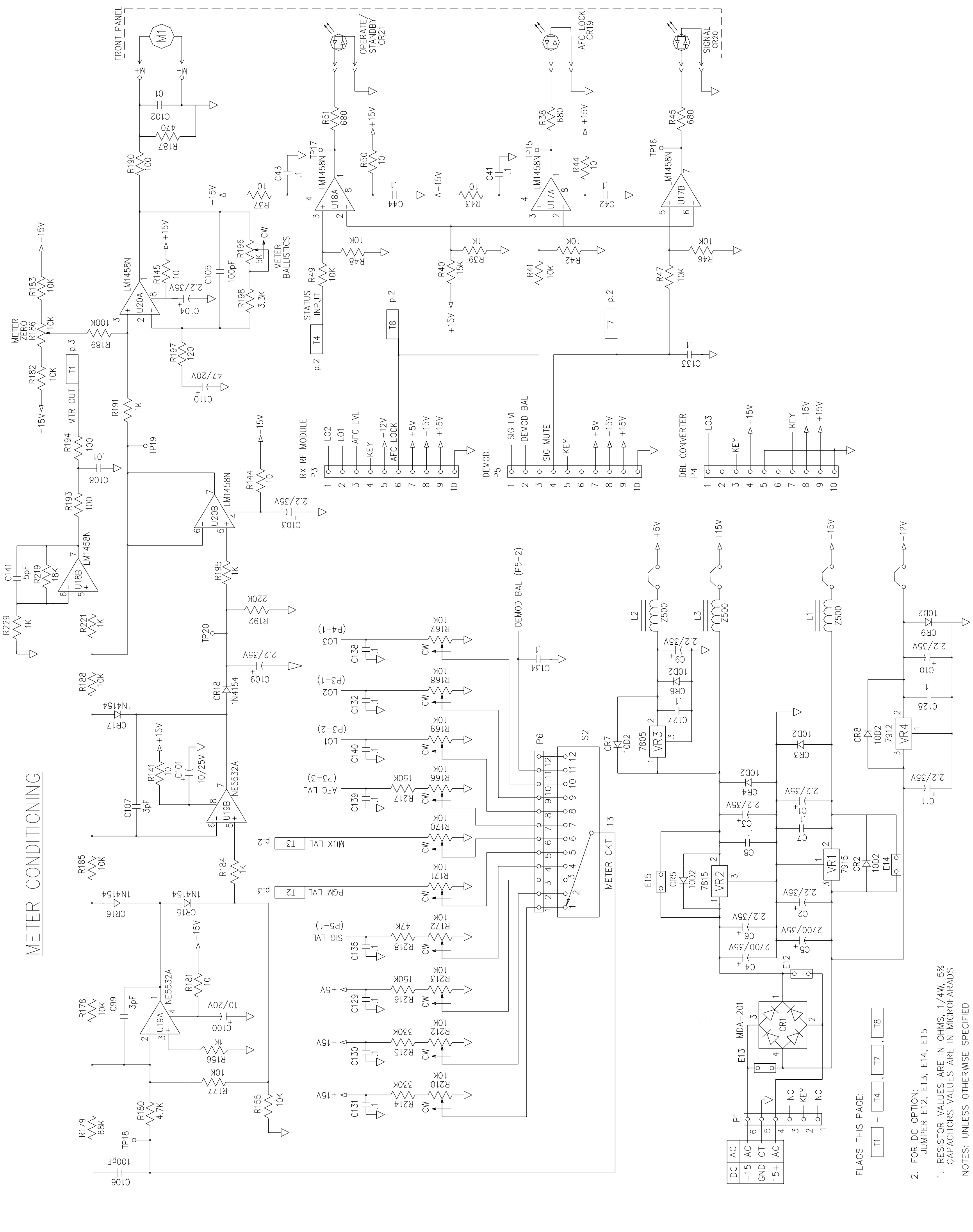
21B2891-1 Rev D
6020 Receiver Final Assembly



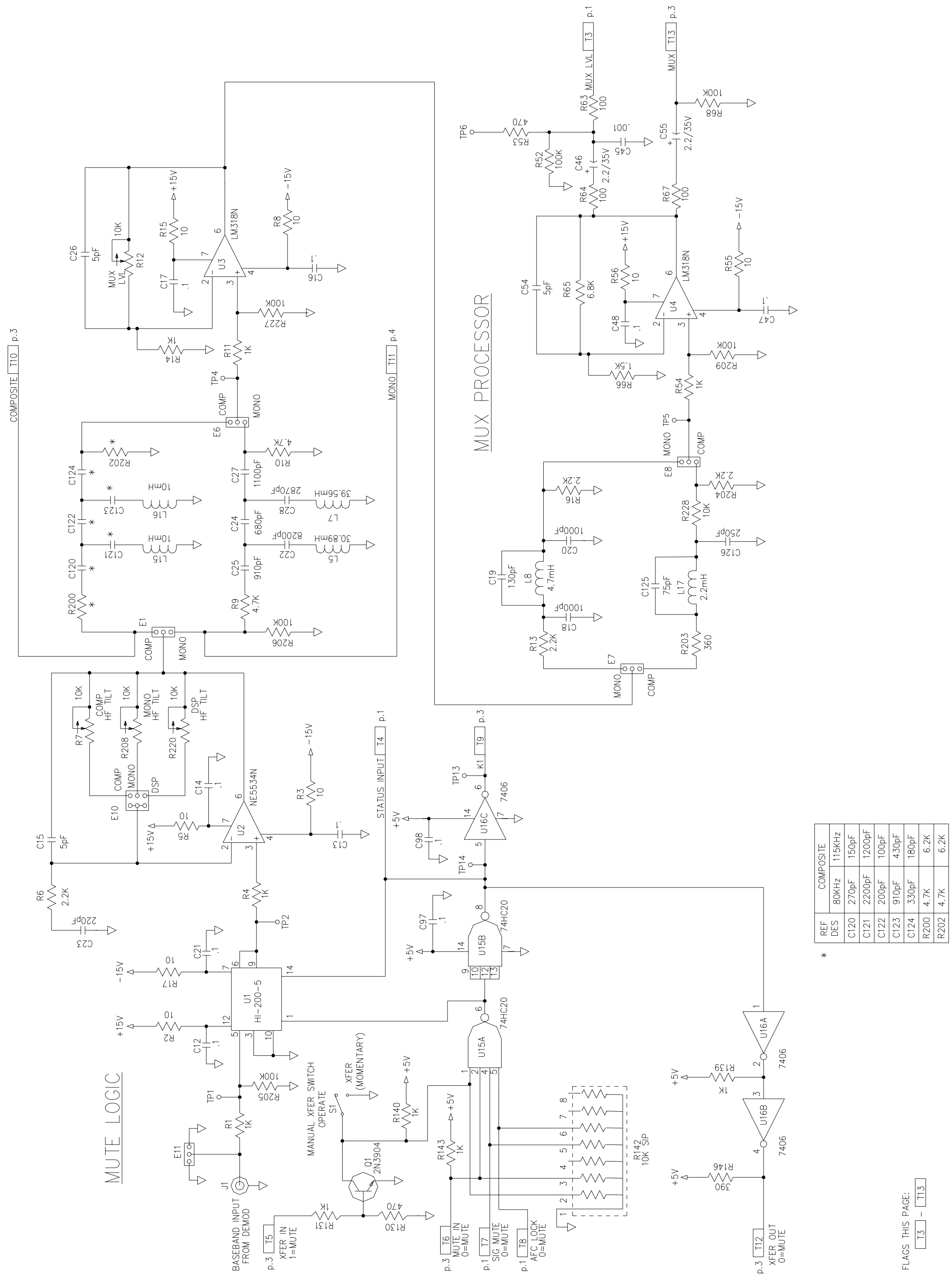
21B2892-1 Rev D
6030 Receiver Final Assembly



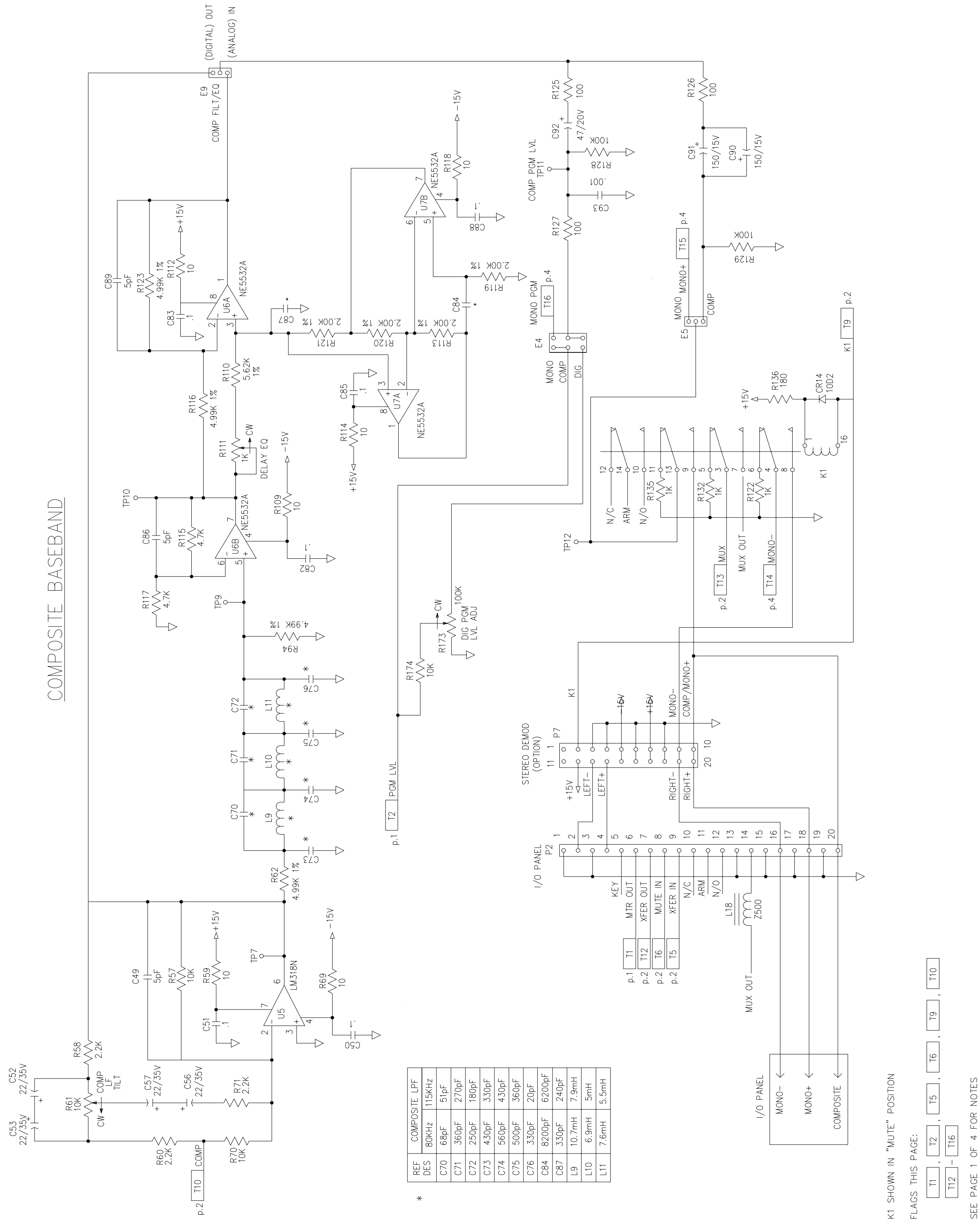
21B2915 Rev D
6060 Receiver Final Assembly



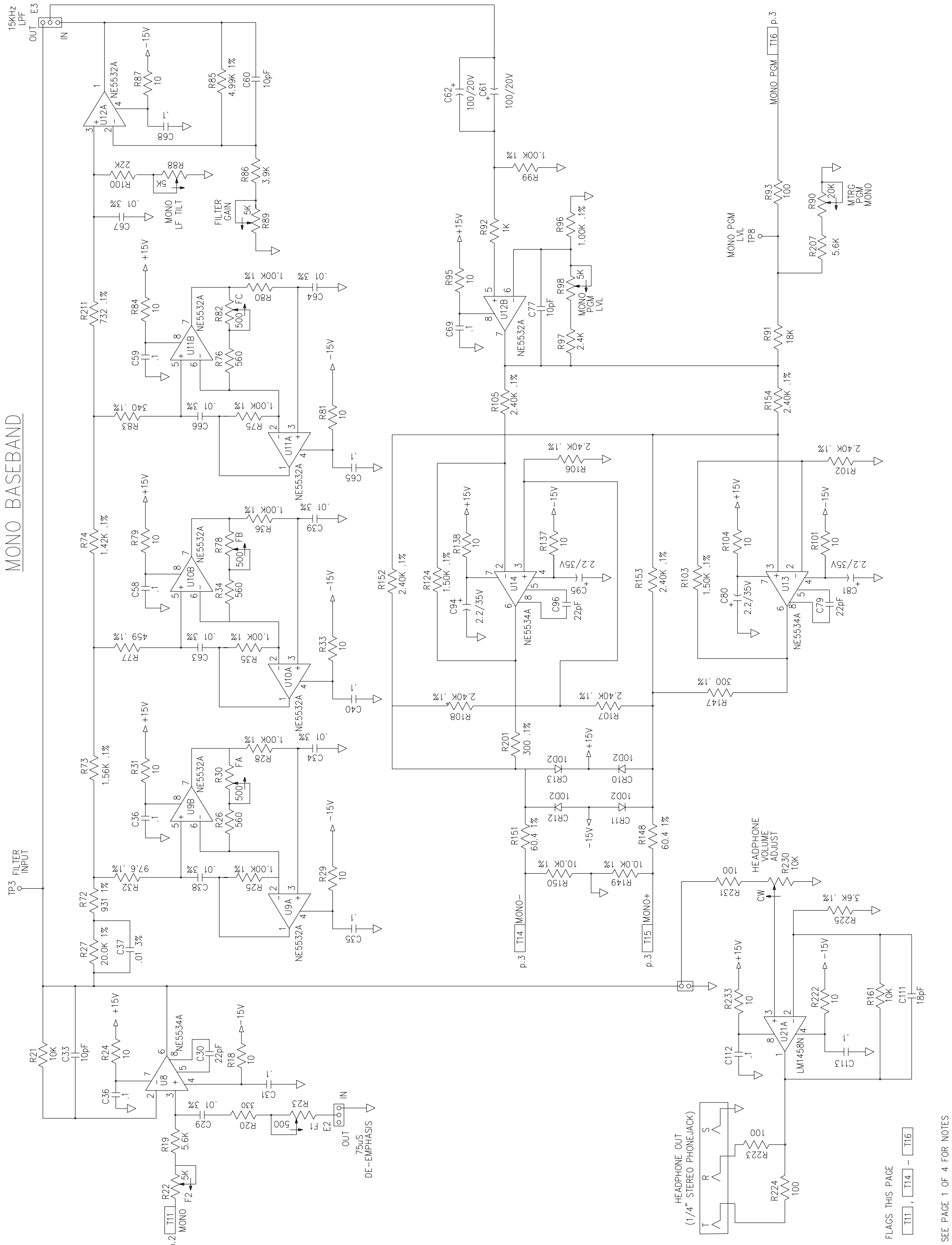
600-10710-01 Rev B
Receiver Audio/Power Supply Schematic, p. 1 of 4



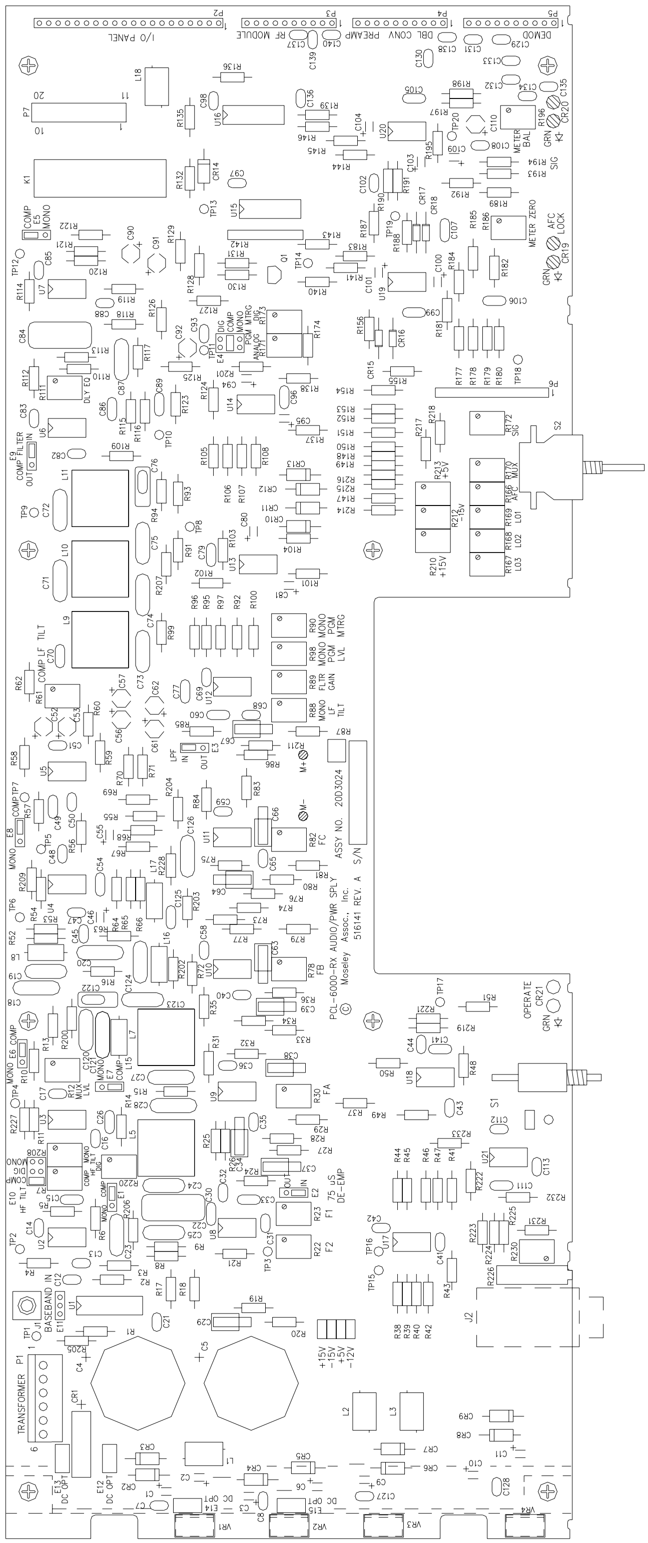
600-10710-01 Rev B
Receiver Audio/Power Supply Schematic, p. 2 of 4



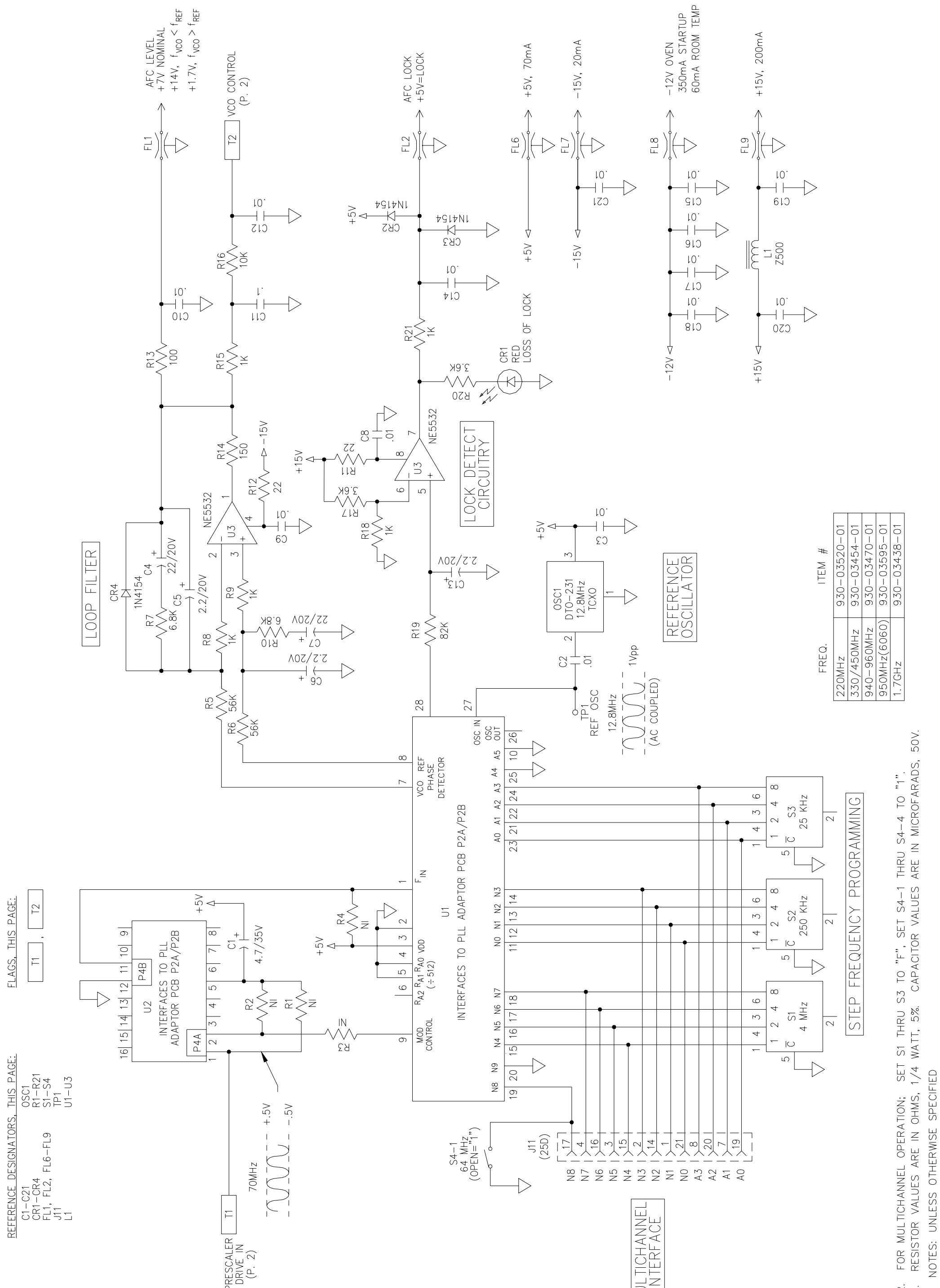
600-10710-01 Rev B
Receiver Audio/Power Supply Schematic, p. 3 of 4



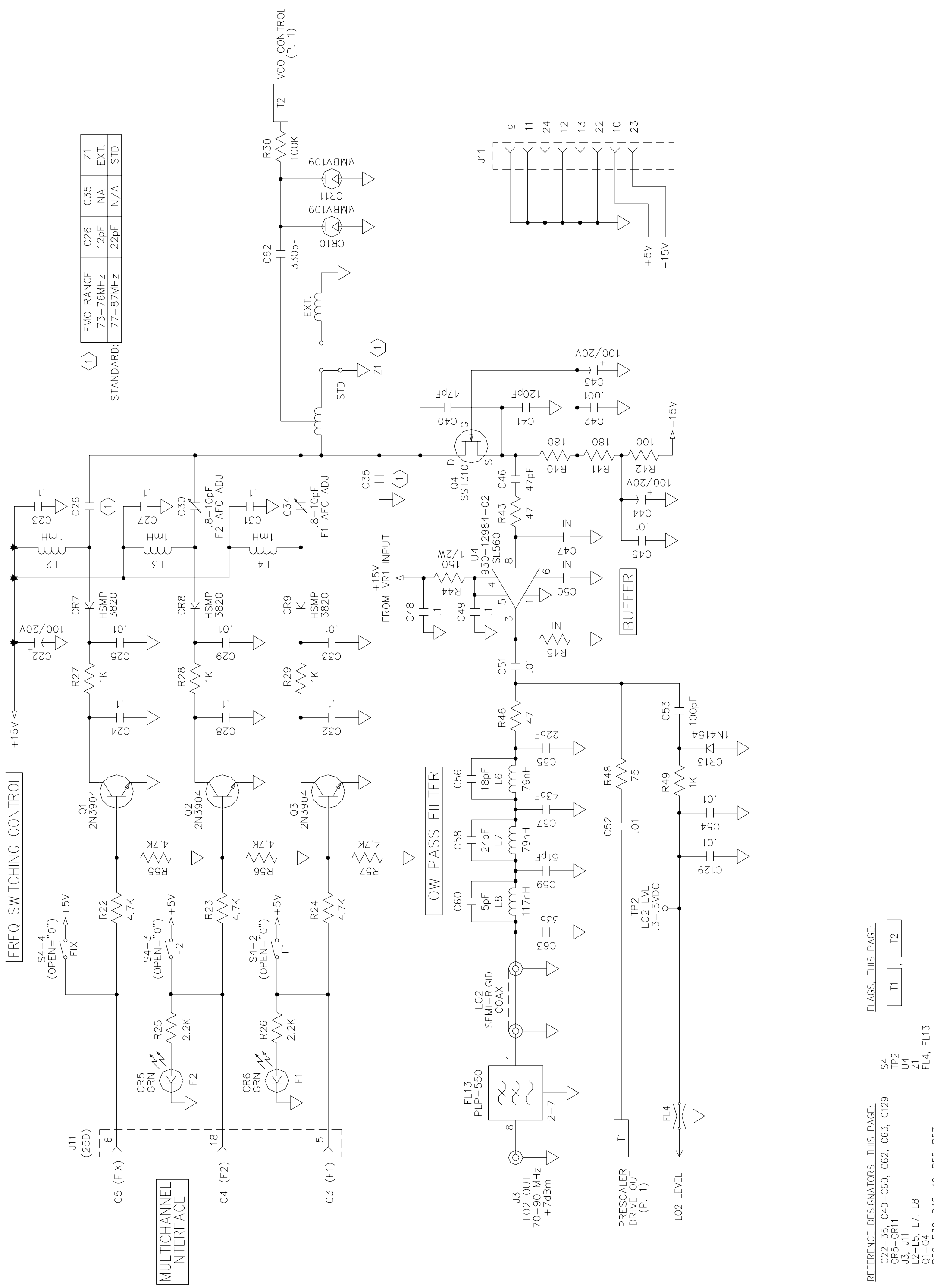
600-10710-01 Rev B
Receiver Audio/Power Supply Schematic, p. 4 of 4



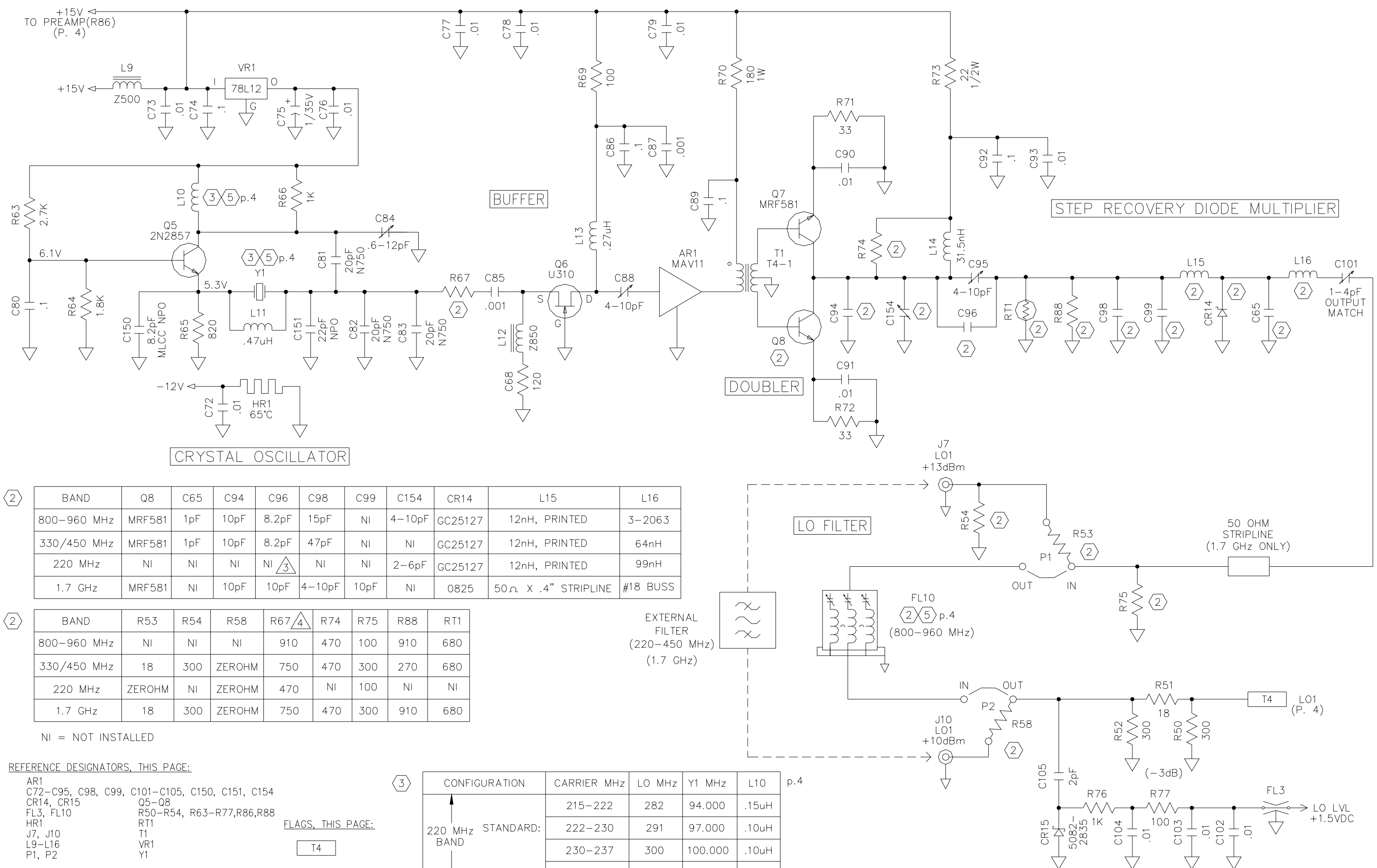
20B3024 Rev C
Receiver Audio/Power Supply Assembly



600-10228-01 Rev K
Receiver RF Module Schematic, p. 1 of 4



600-10228-01 Rev K
Receiver RF Module Schematic, p. 2 of 4



2

BAND	Q8	C65	C94	C96	C98	C99	C154	CR14	L15	L16
800-960 MHz	MRF581	1pF	10pF	8.2pF	15pF	NI	4-10pF	GC25127	12nH, PRINTED	3-2063
330/450 MHz	MRF581	1pF	10pF	8.2pF	47pF	NI	NI	GC25127	12nH, PRINTED	64nH
220 MHz	NI	NI	NI	NI 3	NI	NI	2-6pF	GC25127	12nH, PRINTED	99nH
1.7 GHz	MRF581	NI	10pF	10pF	4-10pF	10pF	NI	0825	50Ω X .4" STRIPLINE	#18 BUSS

2

BAND	R53	R54	R58	R67 4	R74	R75	R88	RT1
800-960 MHz	NI	NI	NI	910	470	100	910	680
330/450 MHz	18	300	ZEROHM	750	470	300	270	680
220 MHz	ZEROHM	NI	ZEROHM	470	NI	100	NI	NI
1.7 GHz	18	300	ZEROHM	750	470	300	910	680

NI = NOT INSTALLED

REFERENCE DESIGNATORS, THIS PAGE:

AR1
C72-C95, C98, C99, C101-C105, C150, C151, C154
CR14, CR15 Q5-Q8
FL3, FL10 R50-R54, R63-R77,R86,R88
HR1 RT1
J7, J10 T1
L9-L16 VR1
P1, P2 Y1

FLAGS, THIS PAGE:

T4

3 p.4

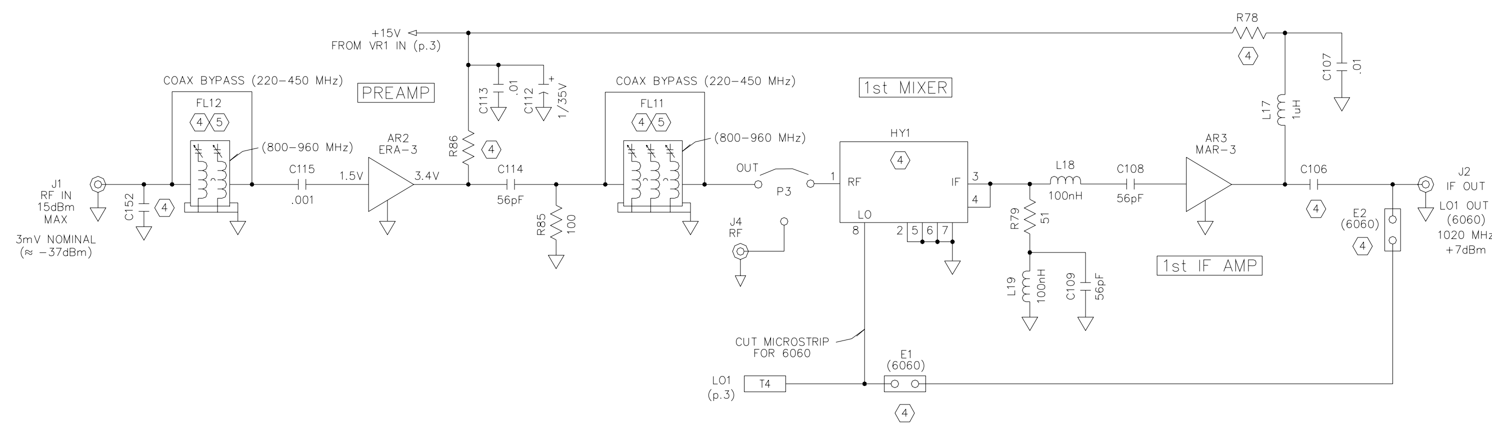
CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz	L10
220 MHz BAND	STANDARD:	215-222	282	94.000	.15uH
		222-230	291	97.000	.10uH
		230-237	300	100.000	.10uH
		237-247	311	103.667	.10uH
330 MHz BAND	STANDARD:	300-310	372	93.000	.15uH
		310-320	385	96.250	.10uH
		320-330	392	98.000	.10uH
450 MHz BAND	STANDARD:	440-450	372	93.000	.15uH
		450-460	385	96.250	.10uH
		460-470	392	98.000	.10uH

4. R67: SELECT IN TEST FOR LO PWR= +10dBm (+/- 2dBm) POST-FILTER AS REQ'D. 470 ≤ R67 ≤ 1K

3. SELECT IN TEST (10pF AS REQ'D)

NOTES UNLESS OTHERWISE SPECIFIED

600-10228-01 Rev K
Receiver RF Module Schematic, p. 3 of 4



⑤ CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz (p.3)	L10 (p.3)	FL10 (p.3)	FL11 ④	FL12 ④
950 MHz BAND	STANDARD:	940–960	1020	102.000	.10uH	1271	1259	2737
		920–940	1000	100.000	.10uH	1271	1259	2737
		910–920	980	98.000	.10uH	1259	1259	2737
		900–910	980	98.000	.10uH	1259	1278	2737
		880–900	960	96.000	.10uH	1259	1278	2737
		860–880	940	94.000	.10uH	1259	1278	2737
		840–860	920	92.000	.10uH	1259	1328	2774
1.7 GHz BAND	STANDARD:	840–860	920	92.000	.10uH	1259	1328	2774
		820–840	900	90.000	.10uH	1278	1328	2774
		800–820	880	88.000	.10uH	1278	1328	2774
		780–800	860	86.000	.15uH	—	—	—
		760–780	840	84.000	.15uH	—	—	—
		740–760	820	82.000	.15uH	—	—	—

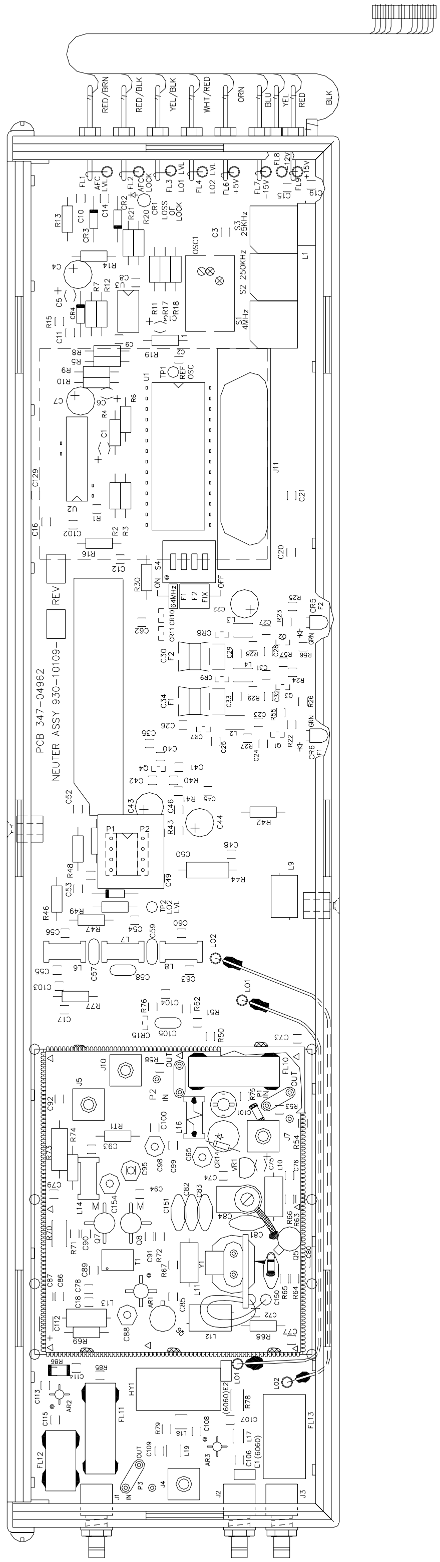
④ BAND	HY1	R86	R78	C106	FL12 / FL11	E1	E2	C152
6020/6030 950 MHz	SRA12	360	360	.01	(SEE CONFIG CHART) ⑤	NI	NI	1.0pF
6060 950 MHz	N/A	NI	NI	NI	NA	JUMPER	JUMPER	1.0pF
330/450 MHz	RFMX1	360	360	.01	COAX BYPASS	NI	NI	NI
220 MHz	RFMX1	360	360	.01	COAX BYPASS	NI	NI	NI
1.7GHz	RFMX1	360	360	.01	COAX BYPASS	NI	NI	NI

NI = NOT INSTALLED

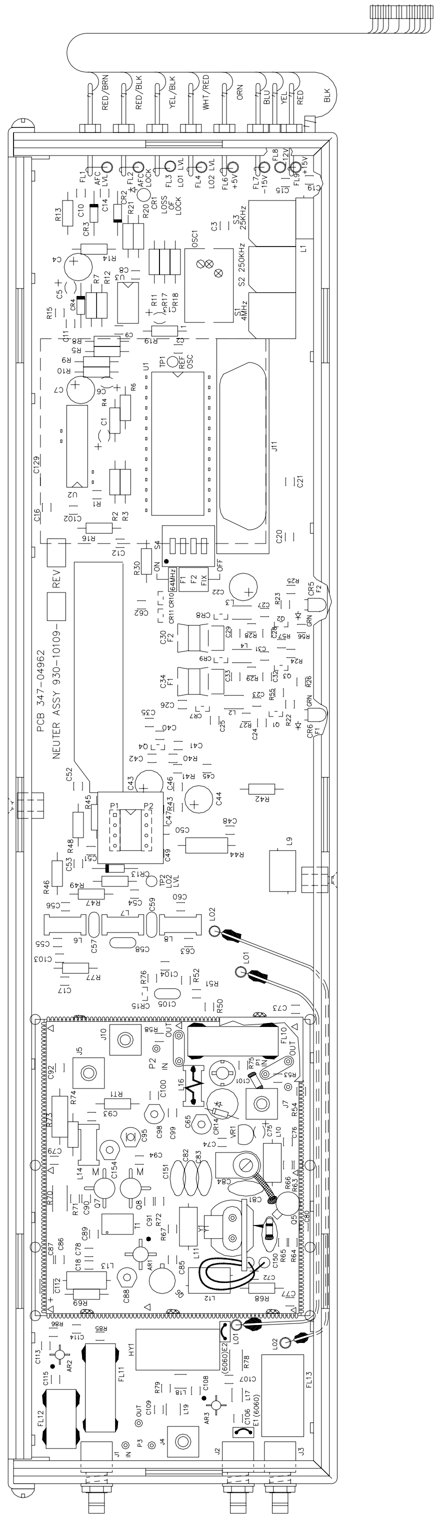
REFERENCE DESIGNATORS, THIS PAGE:
AR2,AR3
C106–C109, C112–C115, C152
E1, E2
FL11, FL12
HY1
J1, J2, J4
L17–L19
P3
R78, R79, R85, R86
Z2

FLAGS, THIS PAGE:
T4

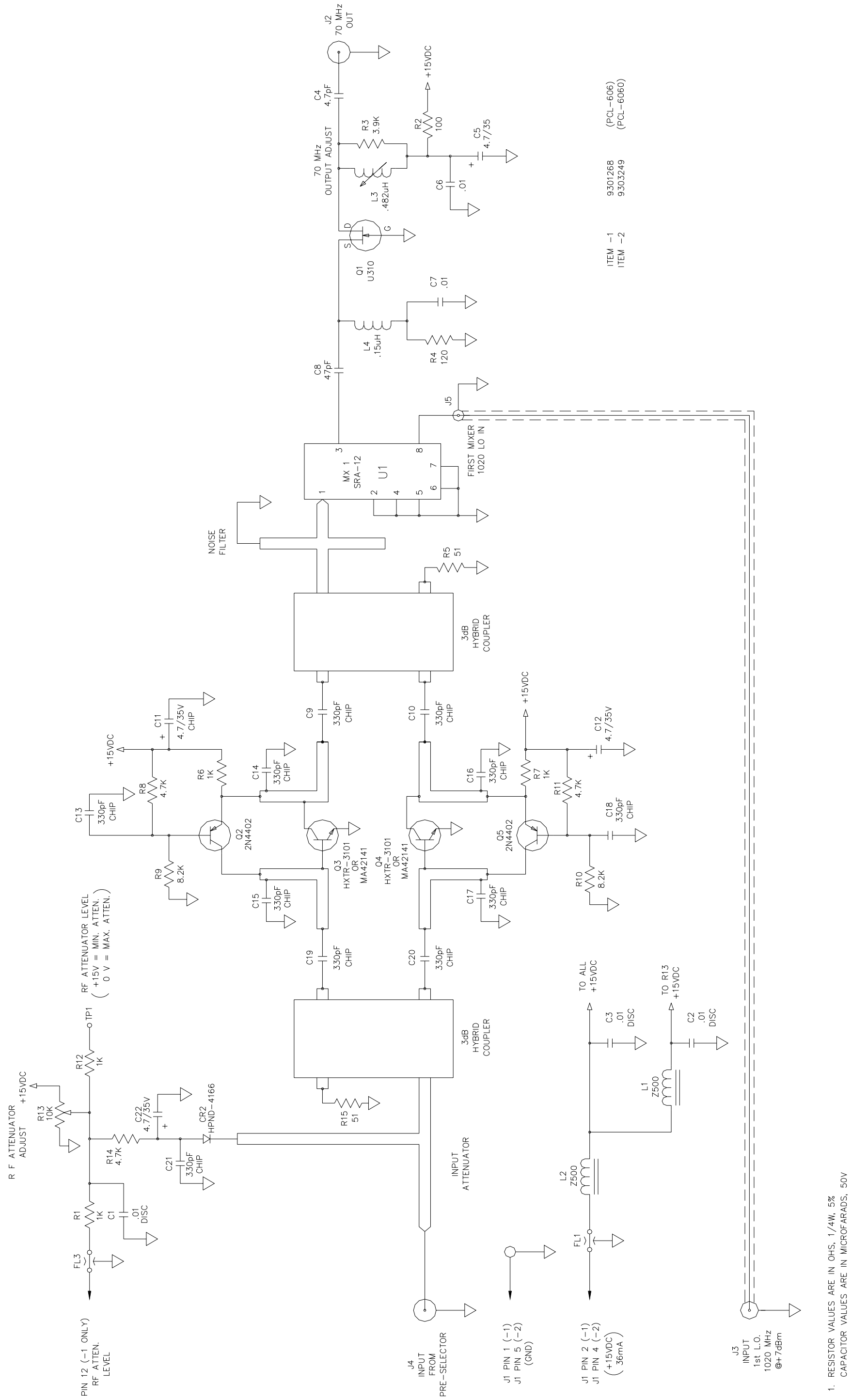
600-10228-01 Rev K
Receiver RF Module Schematic, p. 4 of 4



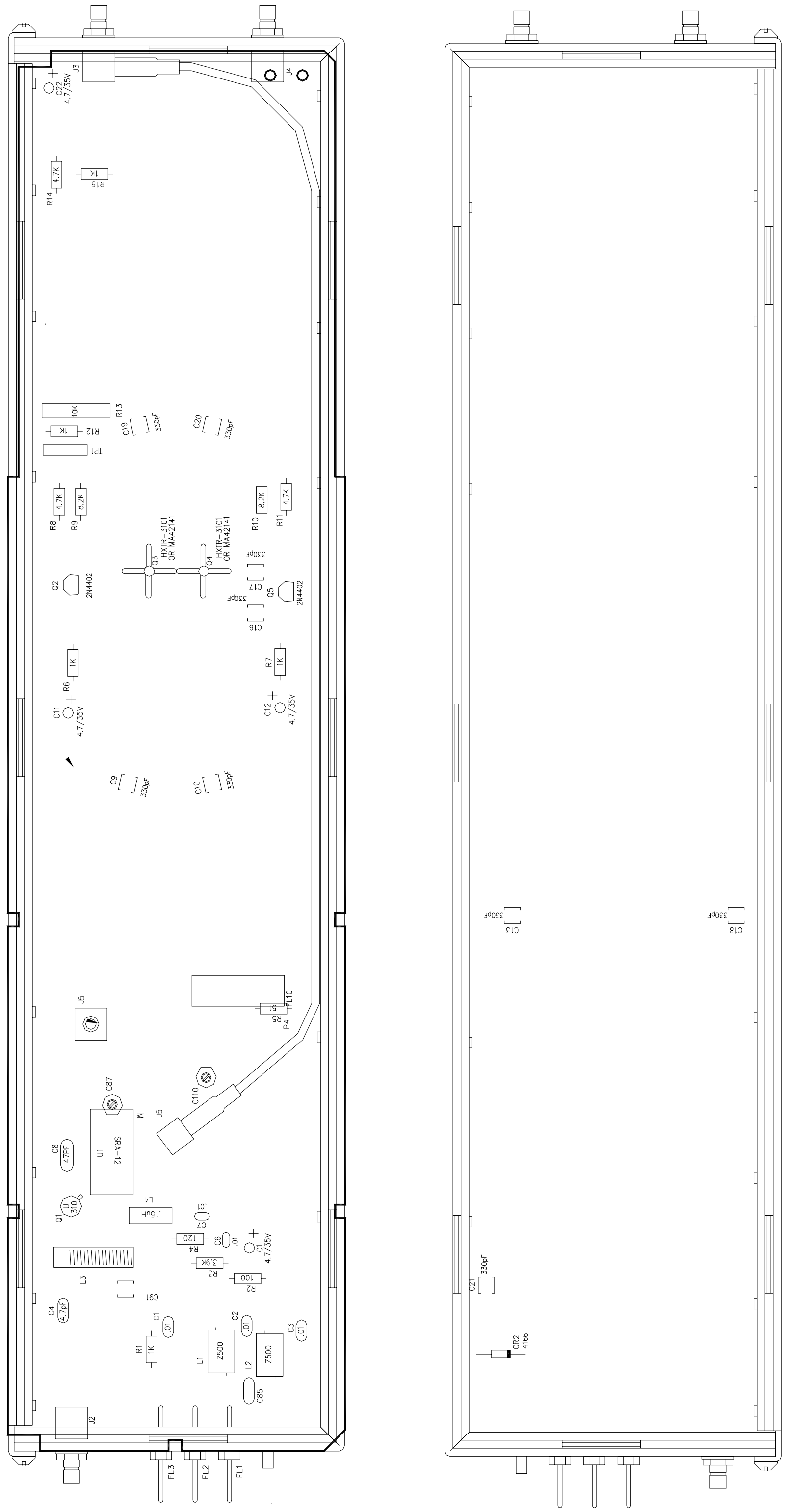
930-03740-01 Rev J
Receiver RF Module (6020/6030) Assembly



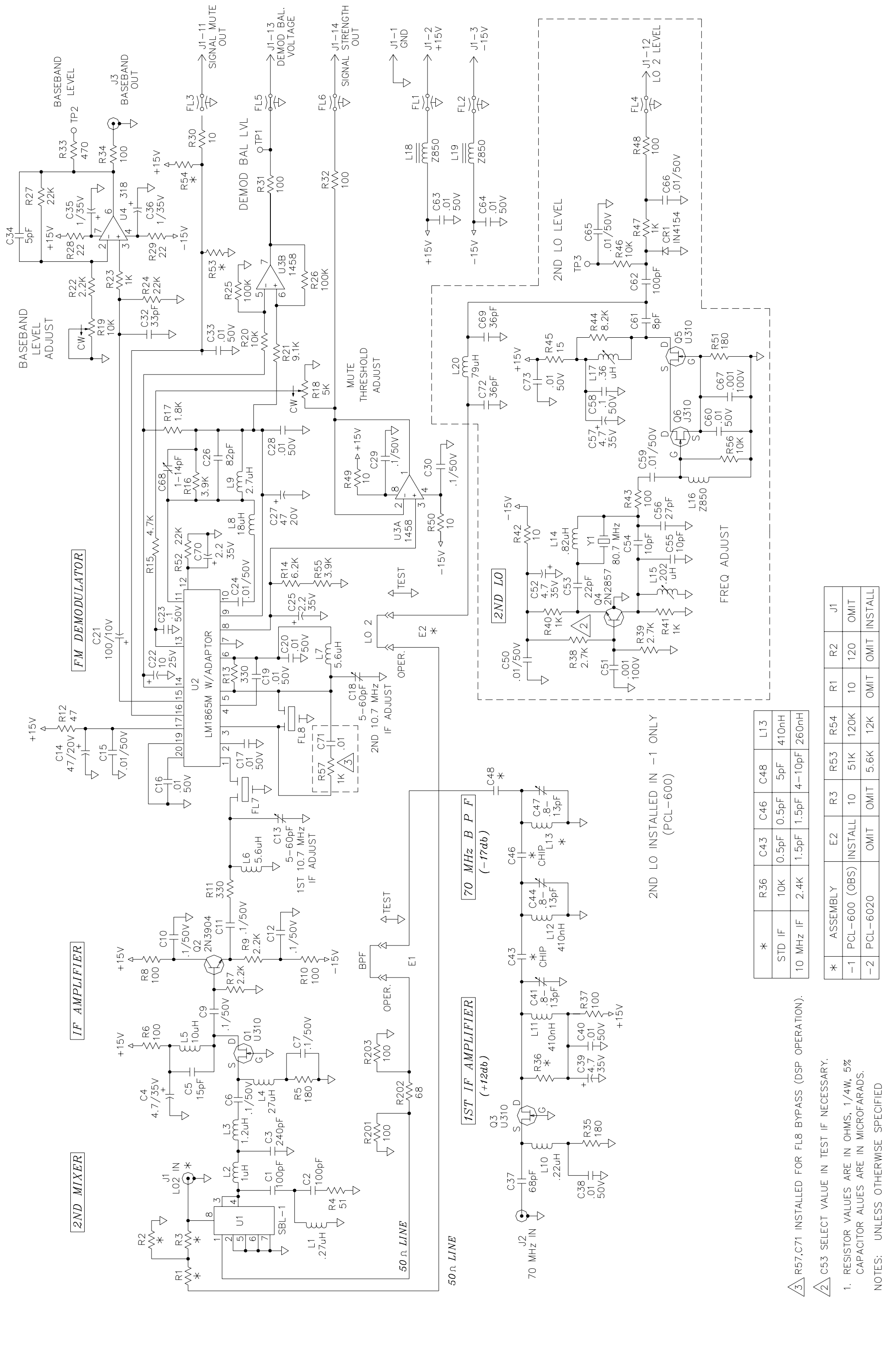
930-03595-01 Rev J
Receiver RF Module (6060) Assembly



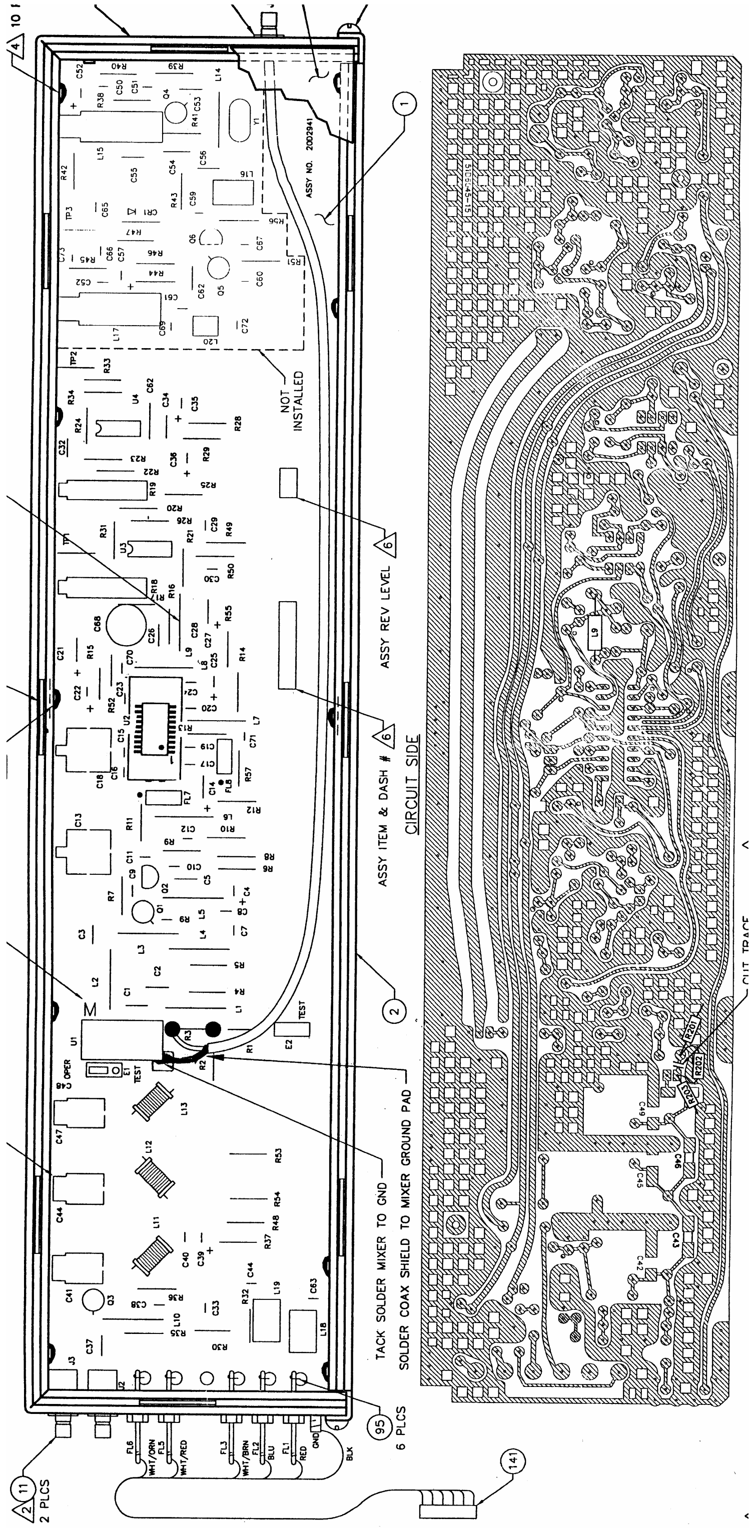
91D7274-2 Rev J
Preamp/1st Mixer (6060) Schematic



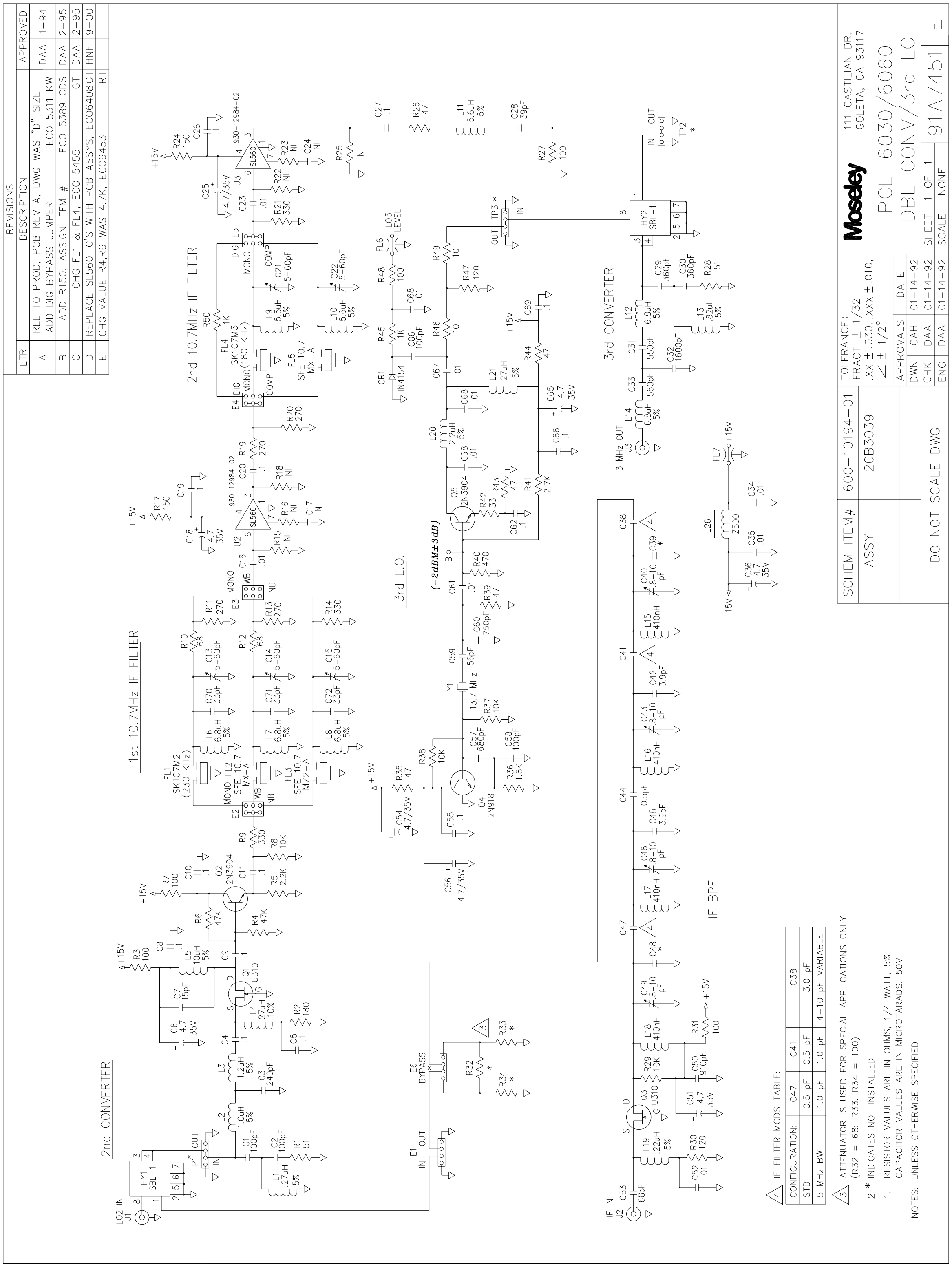
20D2827 Rev P1
Preamp/1st Mixer (6060) Assembly



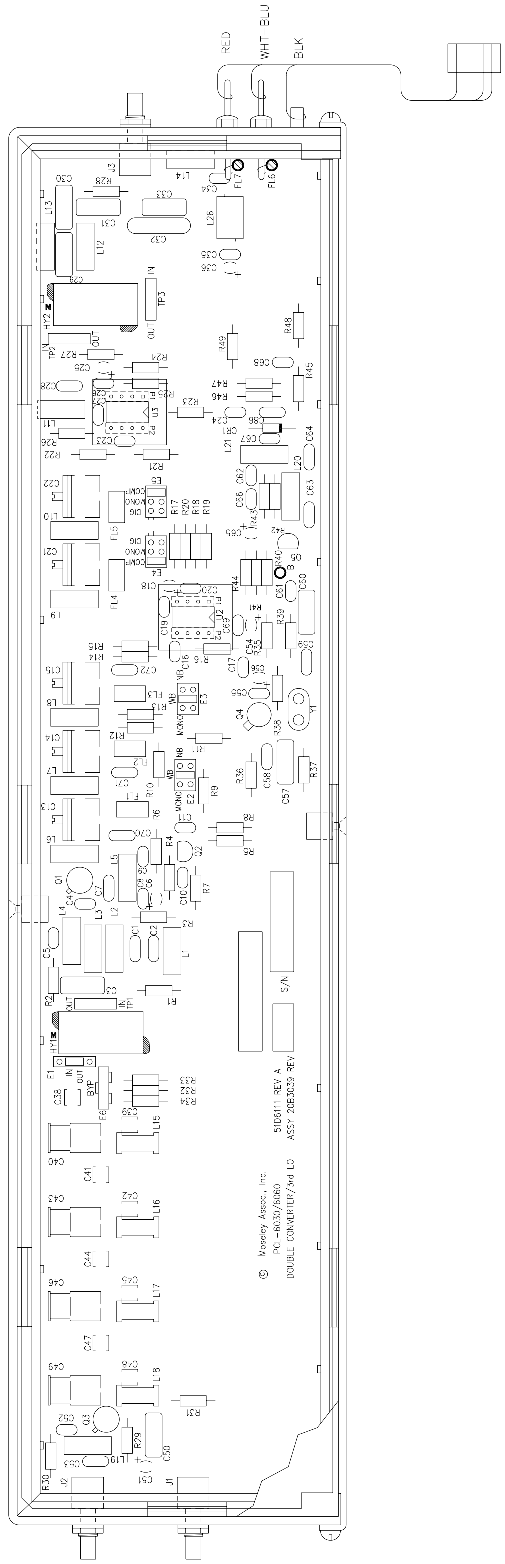
91B7375-Rev C
IF Demod (6020) Schematic



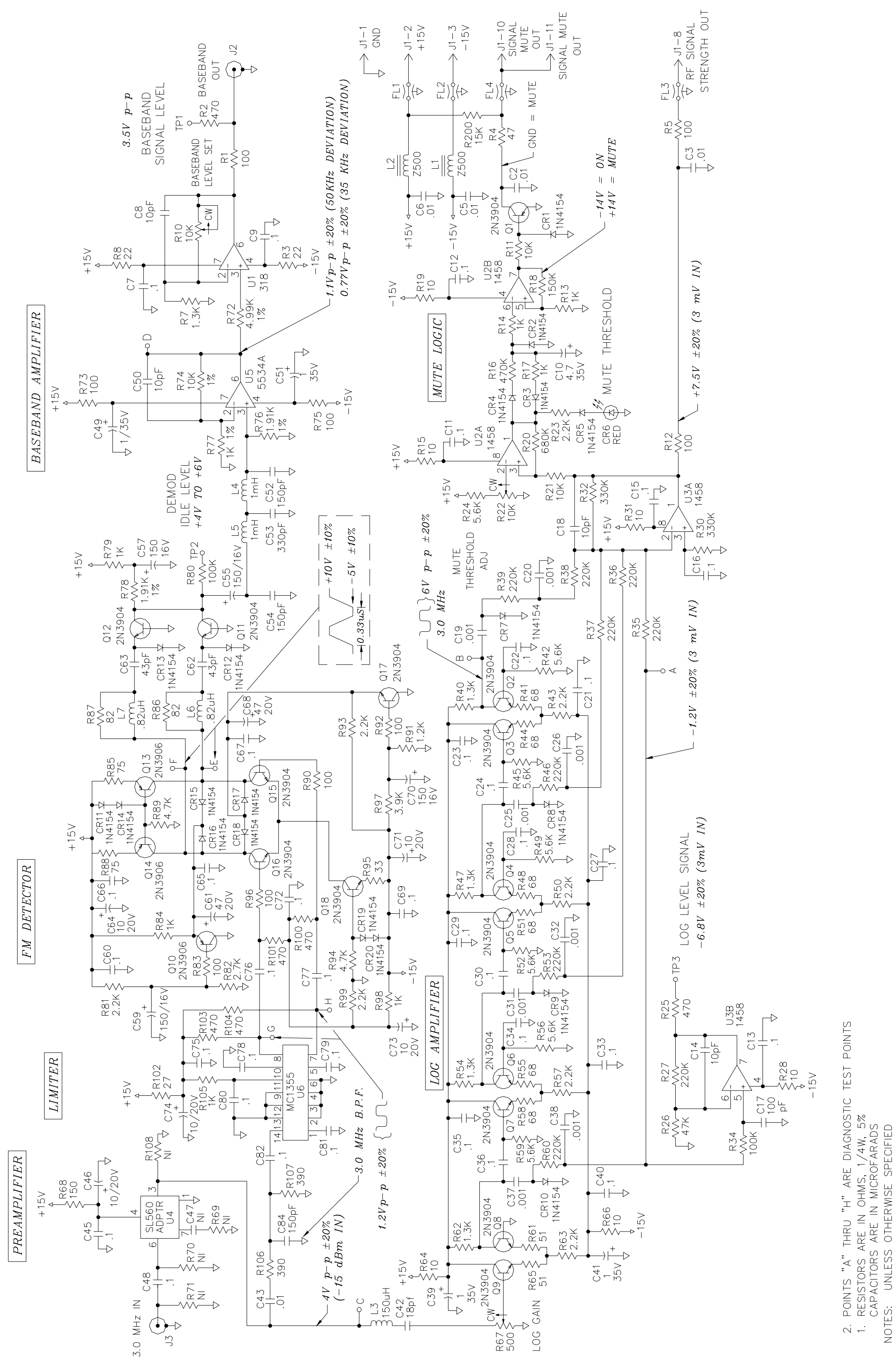
20B2941 Rev C
IF Demod (6020) Assembly



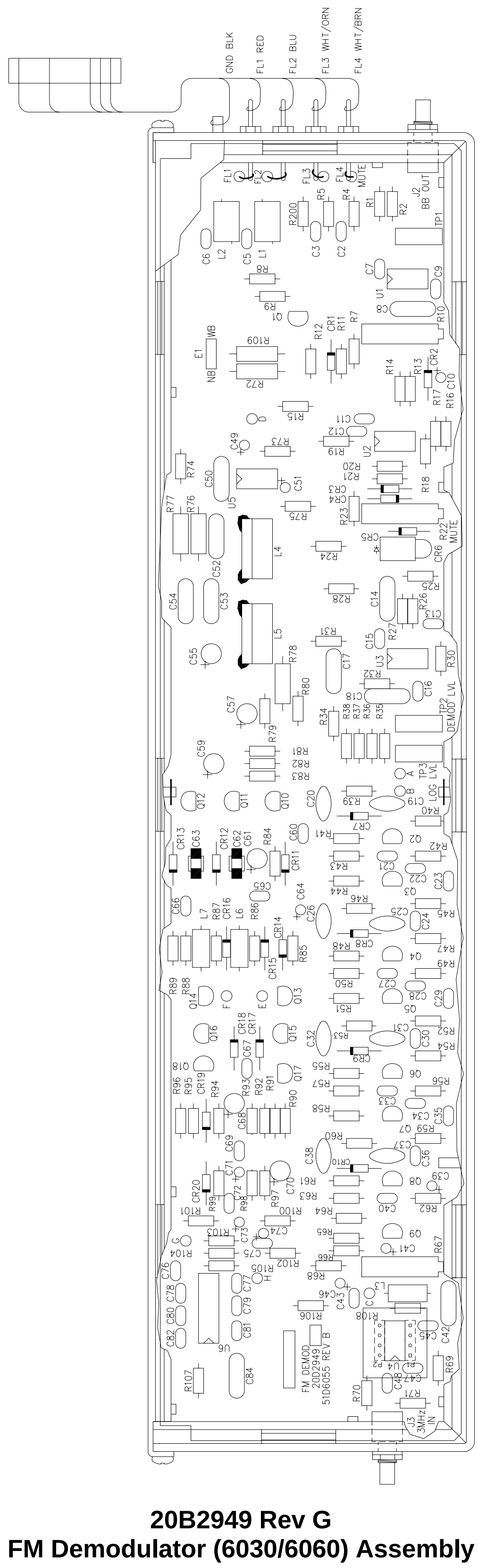
91B7451 Rev E
Double Converter/LO3 (6030/6060) Schematic



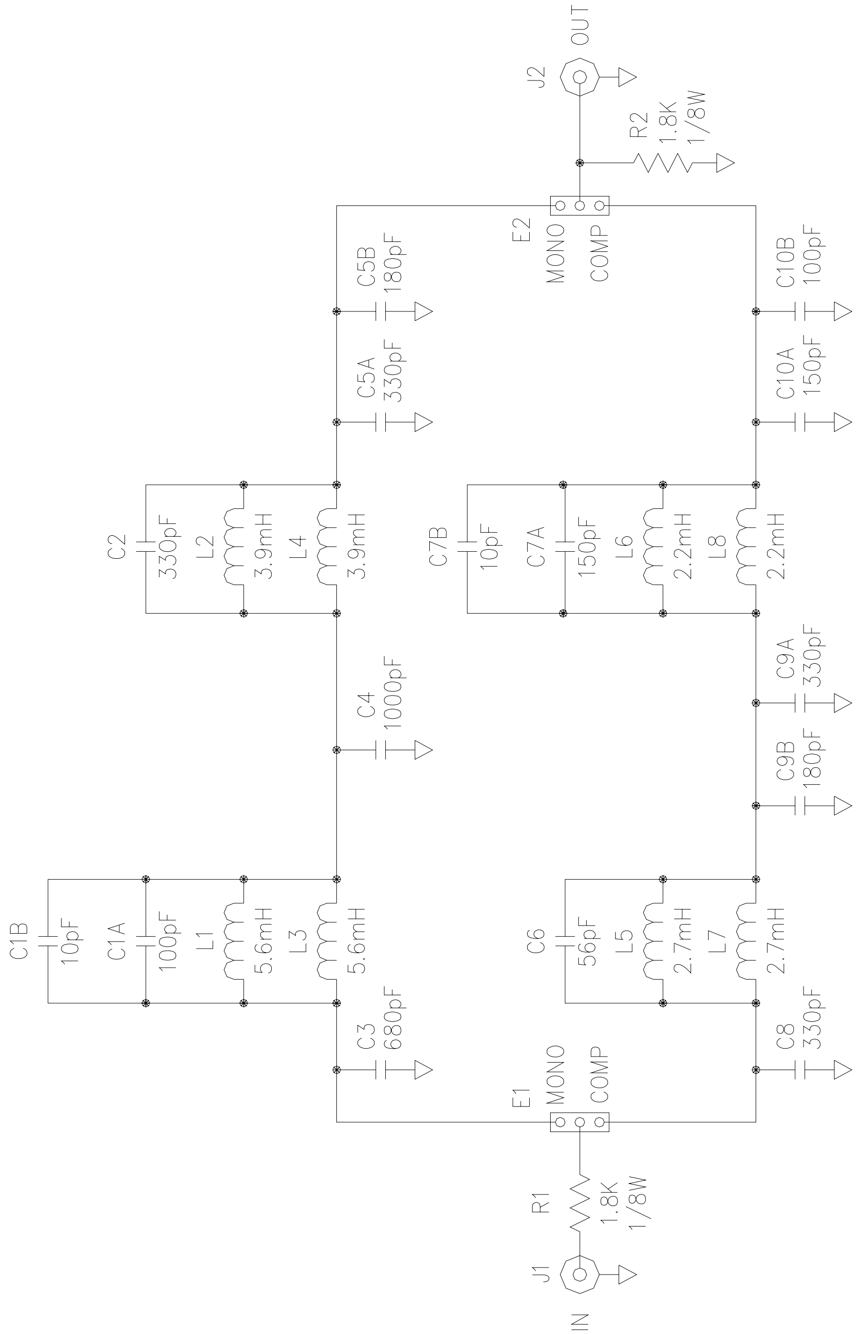
20B3039 Rev E
Double Converter/LO3 (6030/6060) Assembly



91B7387 Rev F
FM Demod (6030/6060) Schematic



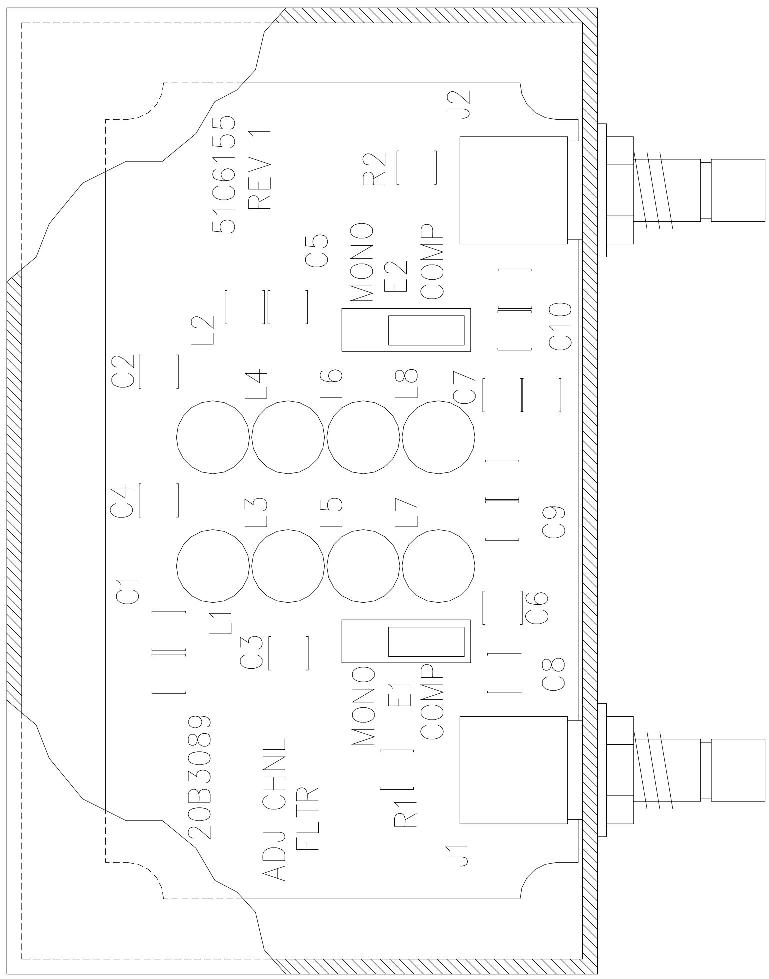
20B2949 Rev G
FM Demodulator (6030/6060) Assembly



NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTOR VALUES ARE IN OHMS, 1/4 WATT

91B7502 Rev 1
Adjacent Channel Filter (6060) Schematic



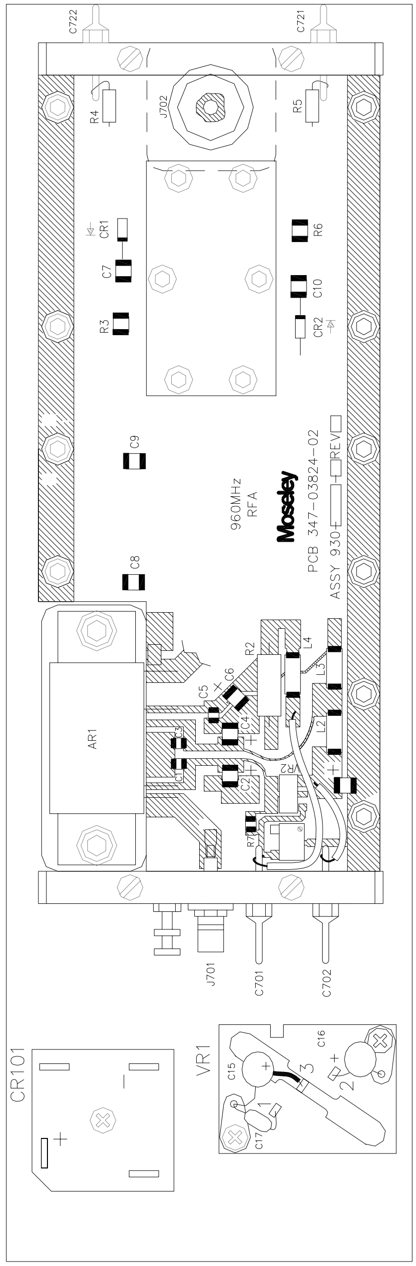
20B3089 Rev 1
Adjacent Channel Filter Assembly

7.4 PCL 6000 1.7 GHz Standard System

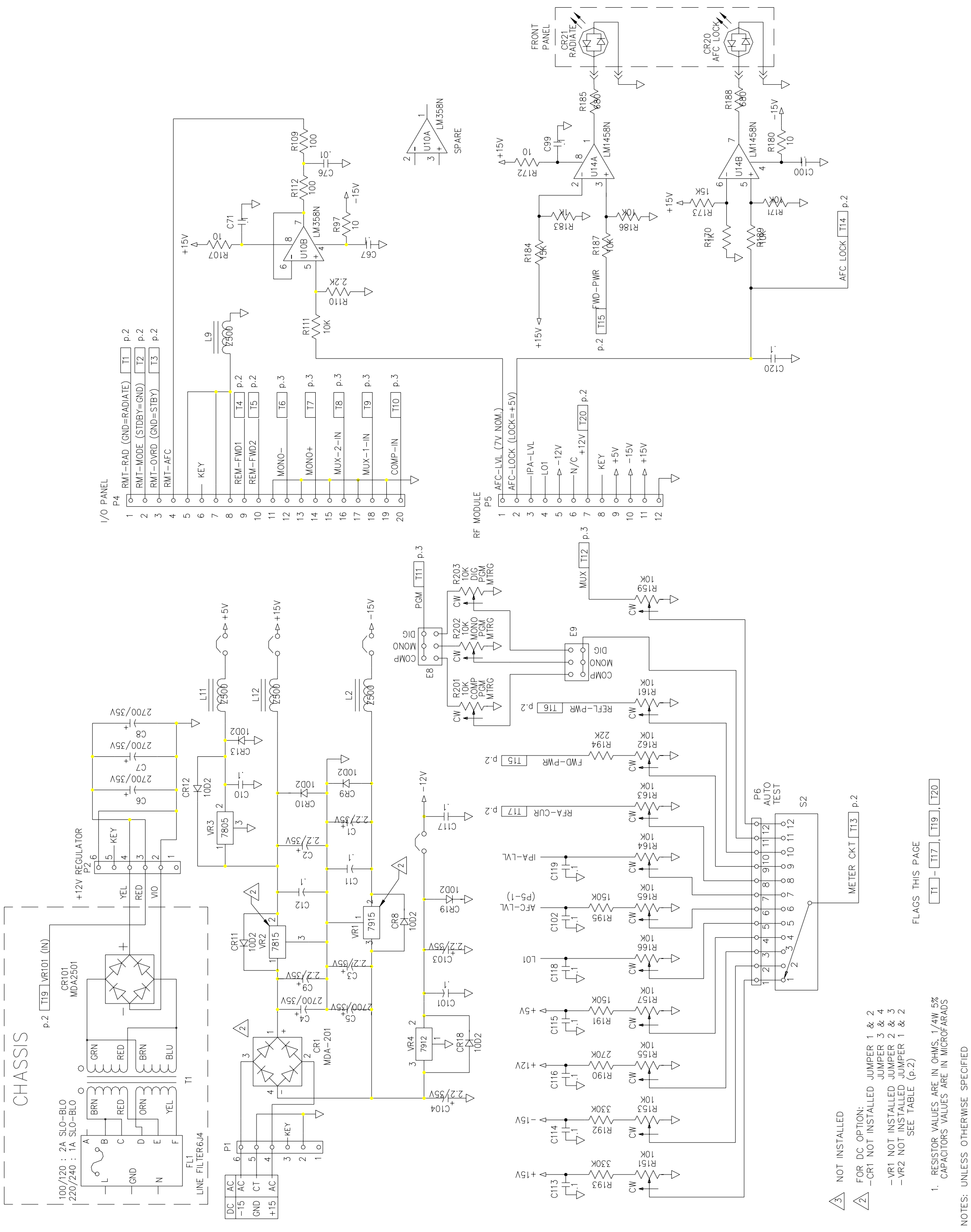
DESCRIPTION	ENG. DWG. No.	REV LEVEL
Transmitter Final Assembly	930-02936-03	U
Transmitter Audio/Power Supply Schematic	91A7444	B
Transmitter Audio/Power Supply Assembly	20D3023	D
Transmitter RF Module Schematic	600-10227-01	H
Transmitter RF Module Assembly	930-03462-01	H
RF Amplifier (1.7 GHz, 6w) Schematic	930-12053-02	B
RF Amplifier (1.7 GHz, 6w) Assembly	930-12052-02	B
6030 Receiver Final Assembly	21B2927	C
Receiver Audio/Power Supply Schematic	600-10710-01	B
Receiver Audio/Power Supply Assembly	20B3024	C
Receiver RF Module Schematic	600-10228-01	K
Receiver RF Module (6030) Assembly	930-03546-01	G
Double Converter(6030) Schematic	91B7451	E
Double Converter(6030) Assembly	20B3039	E
FM Demod (6030) Schematic	91B7387	F
FM Demod (6030) Assembly	20B2949	G

NOTICE:

This section contains schematic and assembly drawings referred to in Sections 1 and 4. For information on individual drawings refer to Section 1 under "System Description" and/or Section 4 under "Module Description".

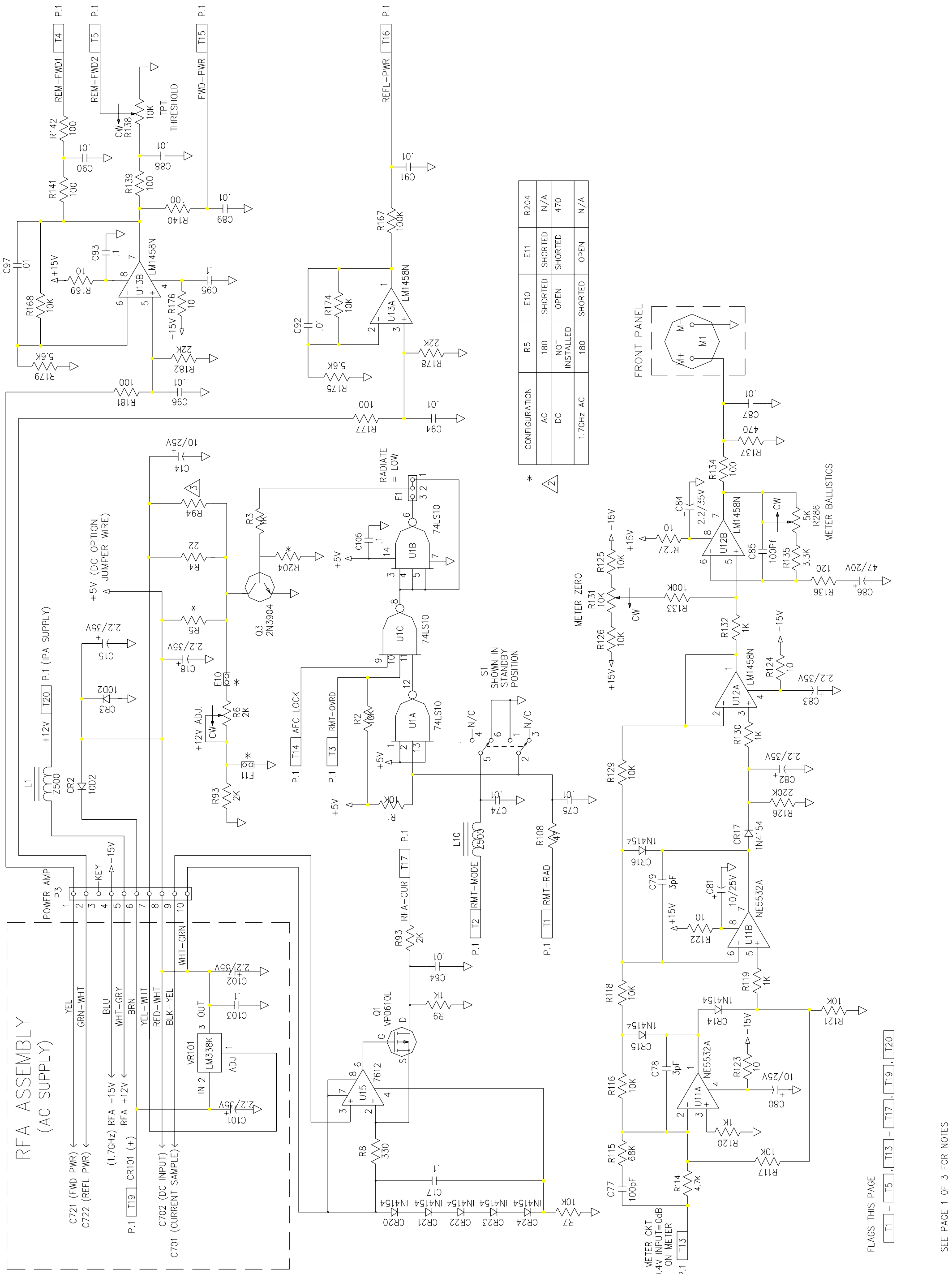


21B2926 Rev C
6010 Transmitter Final Assembly (950 MHz)



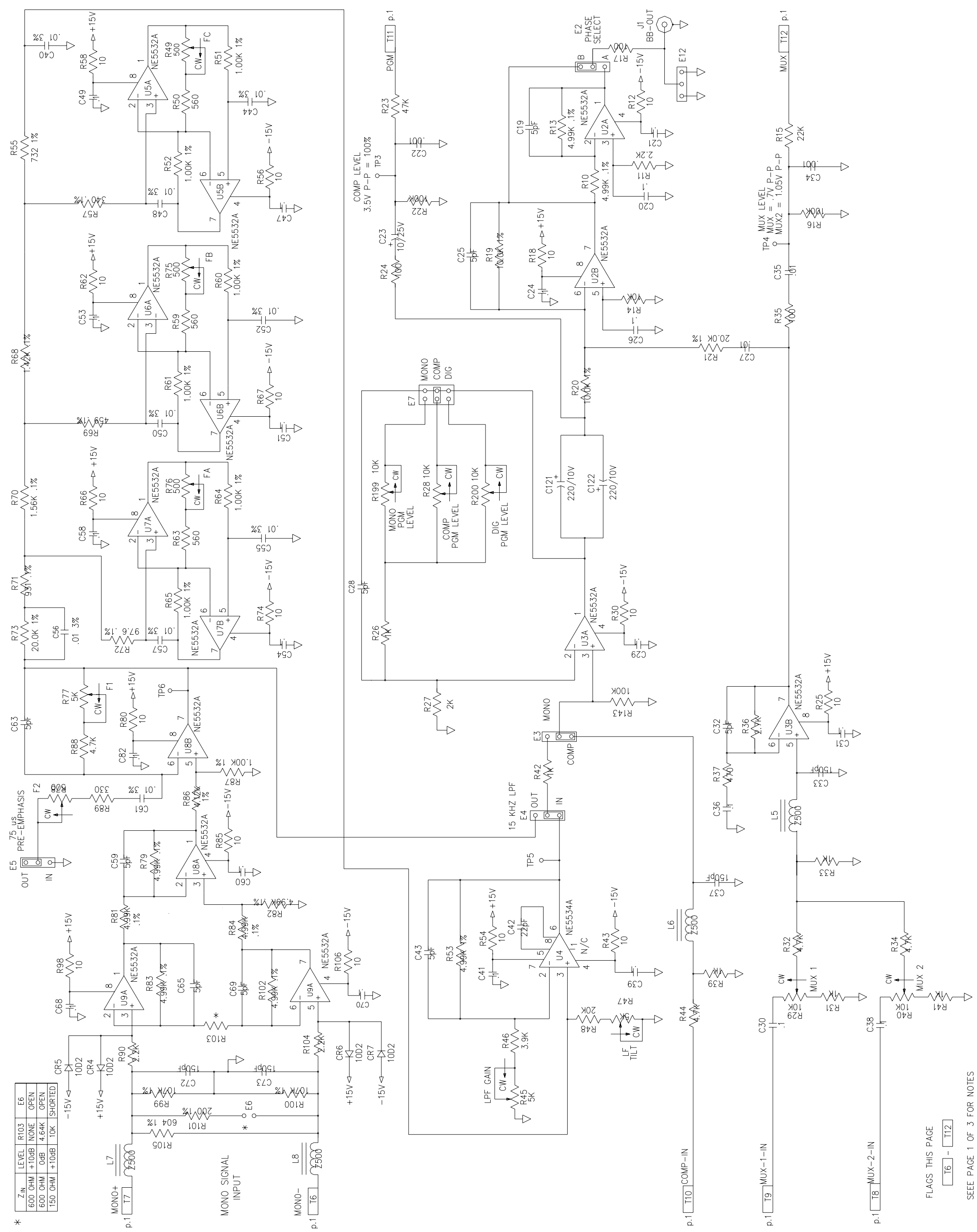
91B7444 Rev B

Transmitter Audio/Power Supply Schematic, p. 1 of 3



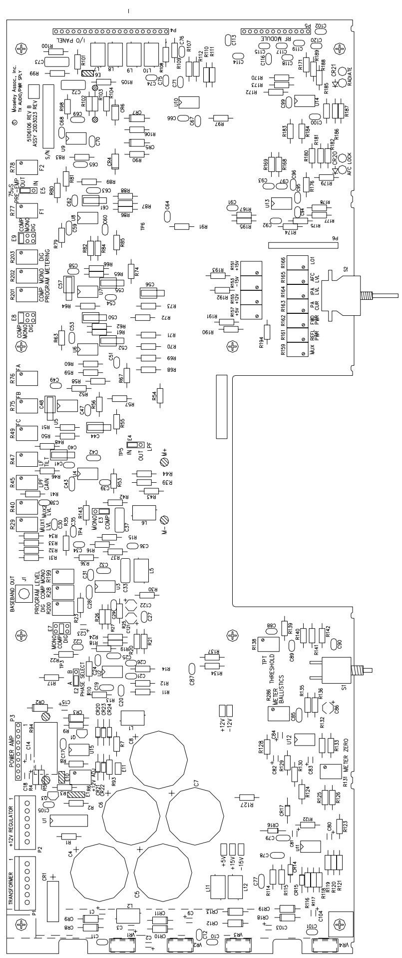
91B7444 Rev B

Transmitter Audio/Power Supply Schematic, p. 2 of 3

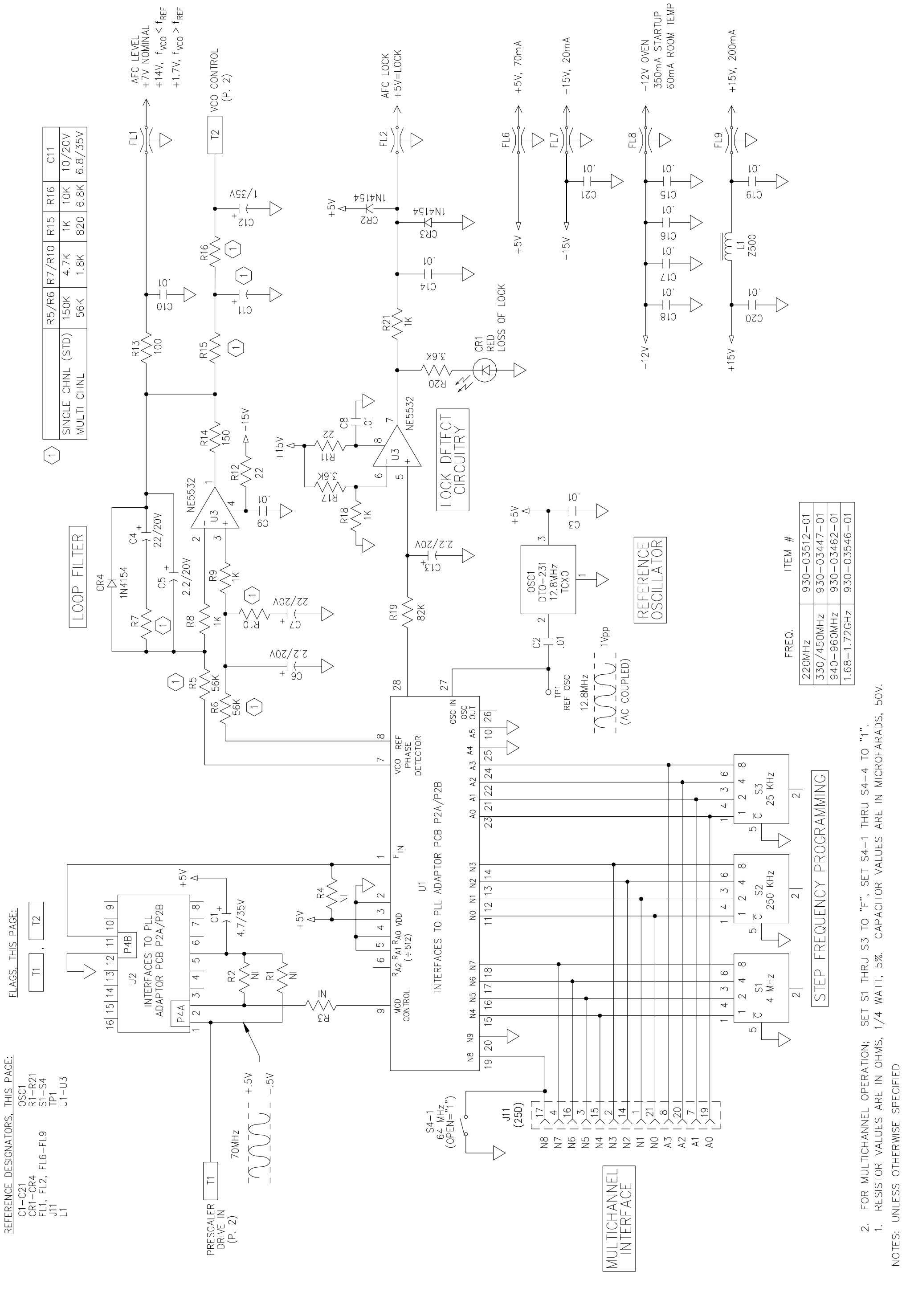


91B7444 Rev B

Transmitter Audio/Power Supply Schematic, p. 3 of 3

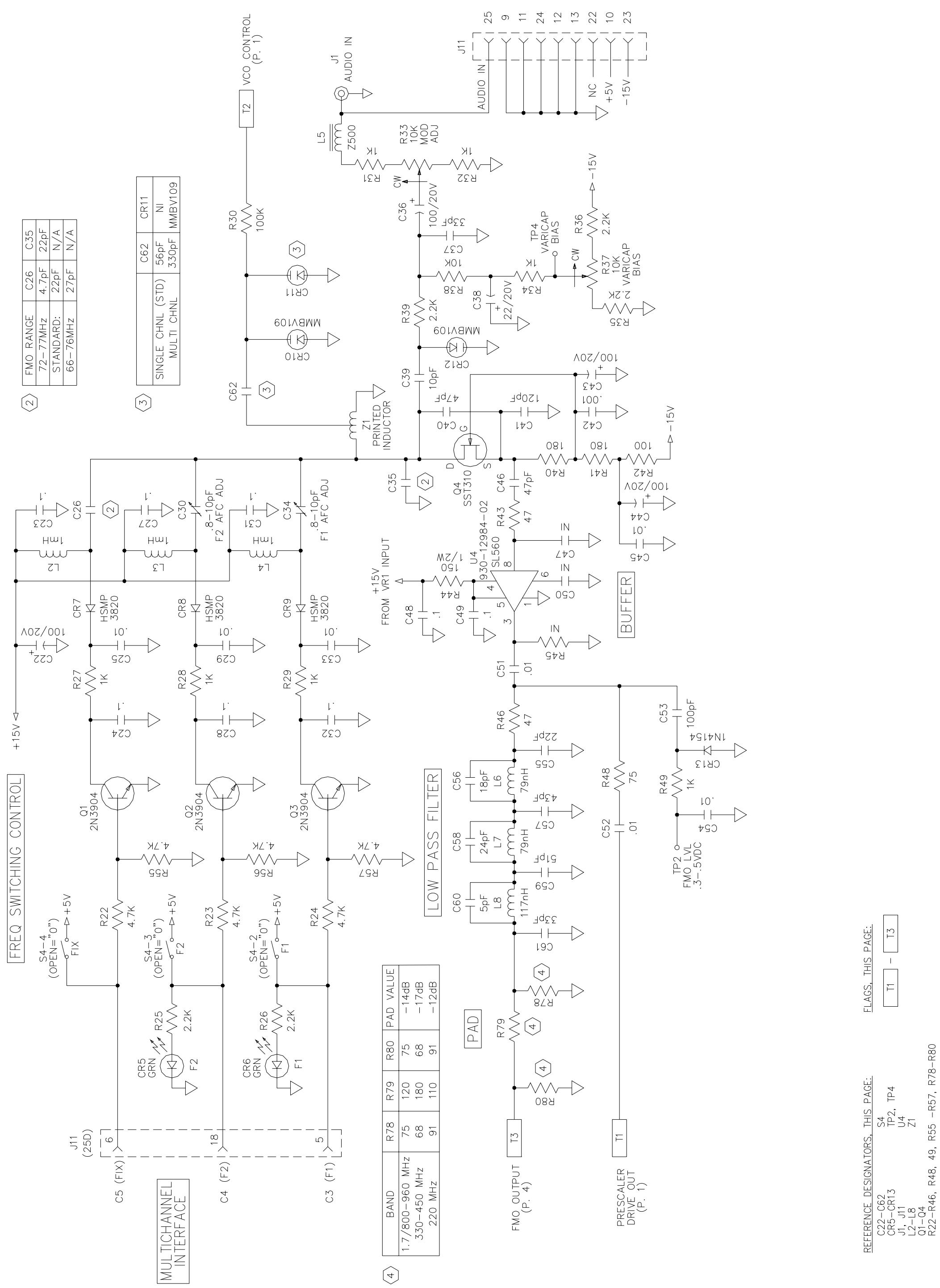


20B3023 Rev D
Transmitter Audio/Power Supply Assembly



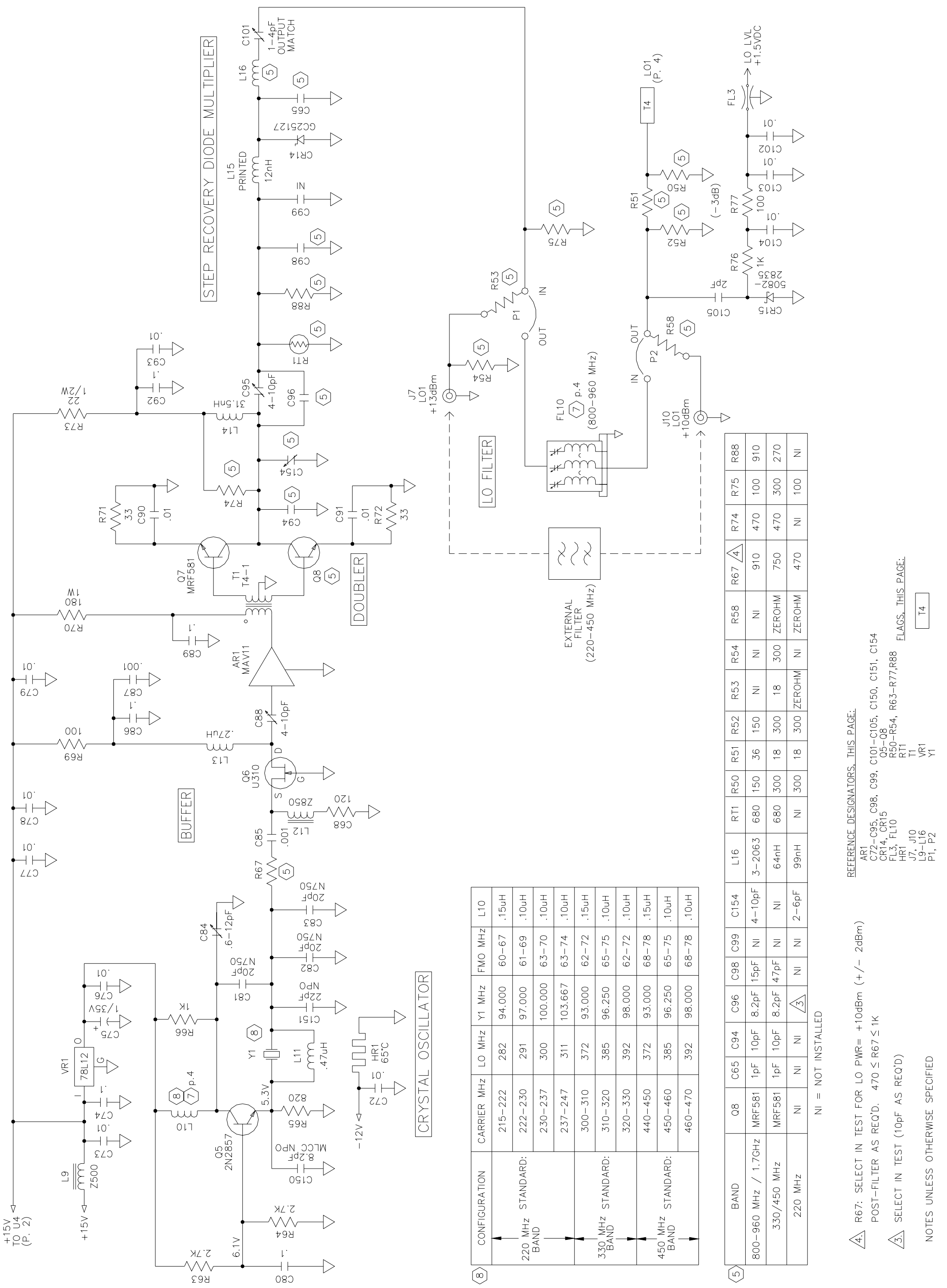
600-10227-01 REV H

Transmitter RF Module Schematic, p. 1 of 4



600-10227-01 REV H

Transmitter RF Module Schematic, p. 2 of 4



(8)

CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz	FMO MHz	L10
220 MHz BAND	STANDARD:	215–222	282	94.000	60–67	.15uH
		222–230	291	97.000	61–69	.10uH
		230–237	300	100.000	63–70	.10uH
		237–247	311	103.667	63–74	.10uH
330 MHz BAND	STANDARD:	300–310	372	93.000	62–72	.15uH
		310–320	385	96.250	65–75	.10uH
		320–330	392	98.000	62–72	.10uH
450 MHz BAND	STANDARD:	440–450	372	93.000	68–78	.15uH
		450–460	385	96.250	65–75	.10uH
		460–470	392	98.000	68–78	.10uH

(5)

BAND	Q8	C65	C94	C96	C98	C99	C154	L16	RT1	R50	R51	R52	R53	R54	R58	R67 (4)	R74	R75	R88
800–960 MHz / 1.7GHz	MRF581	1pF	10pF	8.2pF	15pF	NI	4–10pF	3–2063	680	150	36	150	NI	NI	NI	910	470	100	910
330/450 MHz	MRF581	1pF	10pF	8.2pF	47pF	NI	NI	64nH	680	300	18	300	18	300	ZEROHM	750	470	300	270
220 MHz	NI	NI	NI	(3)	NI	NI	2–6pF	99nH	NI	300	18	300	ZEROHM	NI	ZEROHM	470	NI	100	NI

NI = NOT INSTALLED

(4) R67: SELECT IN TEST FOR LO PWR= +10dBm (+/− 2dBm) POST-FILTER AS REQ'D. 470 ≤ R67 ≤ 1K

(3) SELECT IN TEST (10pF AS REQ'D)

NOTES UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATORS, THIS PAGE:

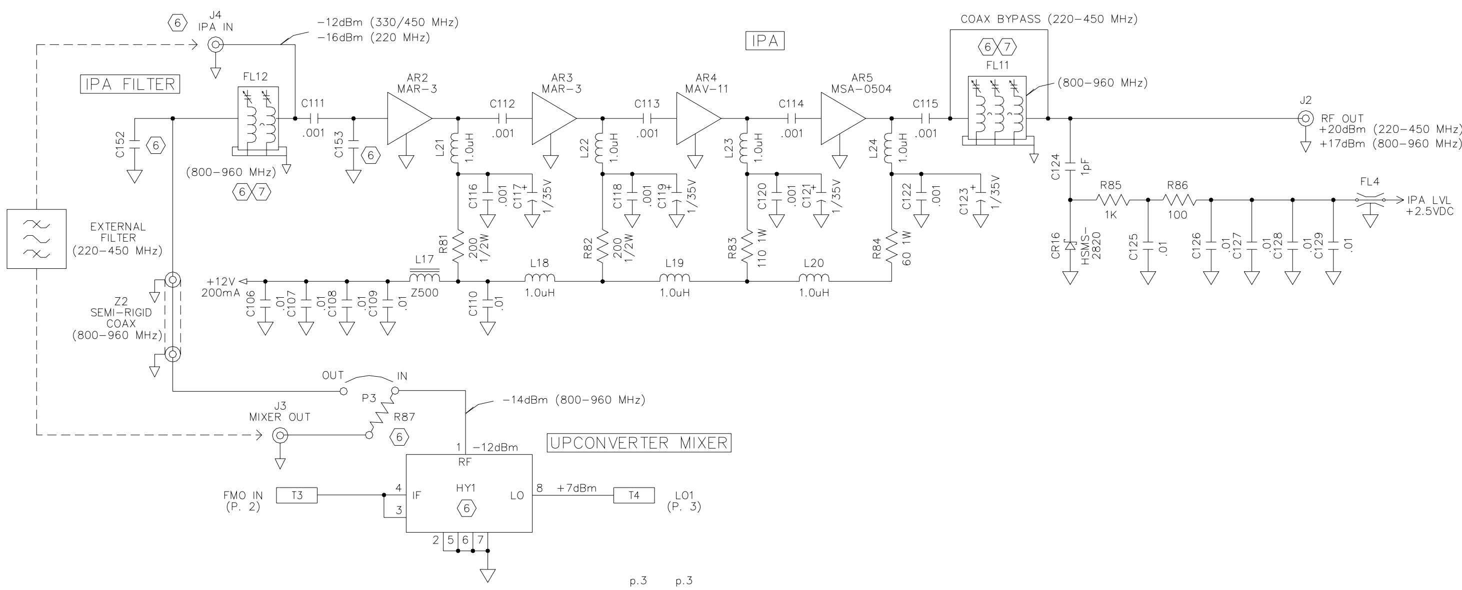
AR1
C72–C95, C98, C99, C101–C105, C150, C151, C154
CR14, CR15
FL3, FL10
HR1
J7, J10
L9–L16
P1, P2
Q5–Q8
R50–R54, R63–R77,R88
RT1
T1
VR1
Y1

FLAGS, THIS PAGE:

T4

600-10227-01 REV H

Transmitter RF Module Schematic, p. 3 of 4



CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz	FMO MHz	L10 (p.3)	FL10 (p.3)	FL11	FL12
950 MHz BAND	STANDARD:	940–960	1020	102.000	60–80	.10uH	1271	1259	2737
		920–940	1000	100.000	60–80	.10uH	1271	1259	2737
		910–920	980	98.000	60–80	.10uH	1259	1259	2737
		900–910	980	98.000	60–80	.10uH	1259	1278	2737
		880–900	960	96.000	60–80	.15uH	1259	1278	2737
		860–880	940	94.000	60–80	.15uH	1259	1278	2737
		840–860	920	92.000	60–80	.15uH	1259	1328	2774
1.7 GHz BAND	1.68–1.72 GHz	840–860	920	92.000	60–80	.15uH	1259	1328	2774
	1.64–1.68 GHz	820–840	900	90.000	60–80	.15uH	1278	1328	2774
	1.60–1.64 GHz	800–820	880	88.000	60–80	.15uH	1278	1328	2774
	1.56–1.60 GHz	780–800	860	86.000	60–80	.15uH	—	—	—
	1.52–1.56 GHz	760–780	840	84.000	60–80	.15uH	—	—	—
	1.48–1.52 GHz	740–760	820	82.000	60–80	.15uH	—	—	—

NOTE: CRYSTALS AND FILTERS ARE INSTALLED IN TEST PER CUSTOMER FREQUENCY.

BAND	R87	FL12	FL11	J4	HY1	C152	C153
1.7/800–960 MHz	NI	(SEE CONFIG CHART) 7		NI	SRA-12	1.0pF	2.2pF
330/450 MHz	ZEROHM	NI	COAX BYPASS	SMB VERT.	RFMX-1	NI	NI
220 MHz	ZEROHM	NI	COAX BYPASS	SMB VERT.	RFMX-1	NI	NI

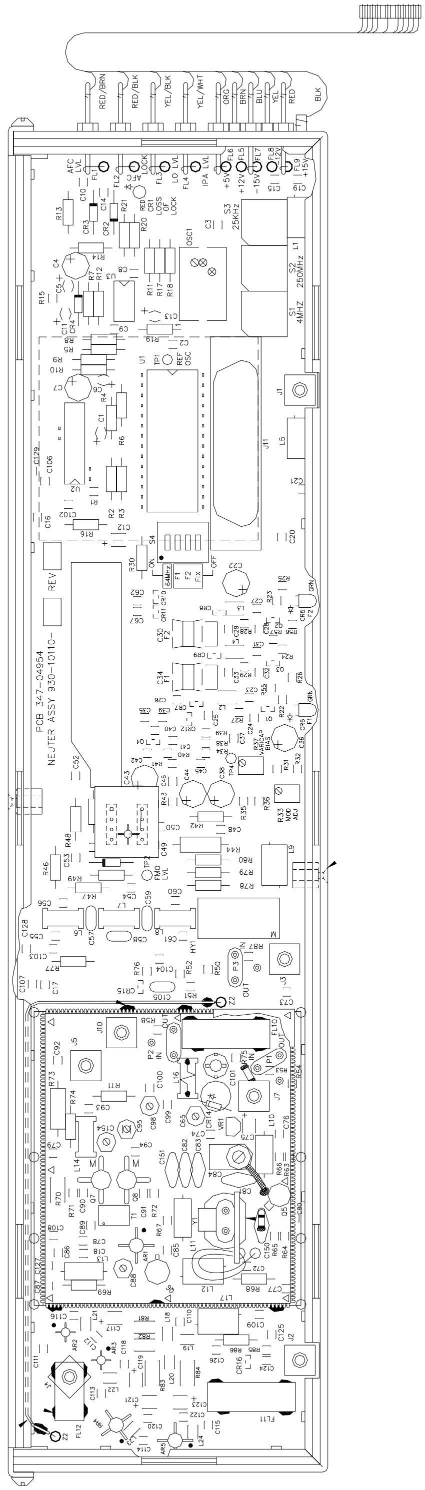
NI = NOT INSTALLED

REFERENCE DESIGNATORS, THIS PAGE:
AR2–AR5
C106–C129, C152, C153
CR16
FL4, FL11, FL12
HY1
J2–J4
L17–24
P3
R81–R87
Z2

FLAGS, THIS PAGE:
T3 , T4

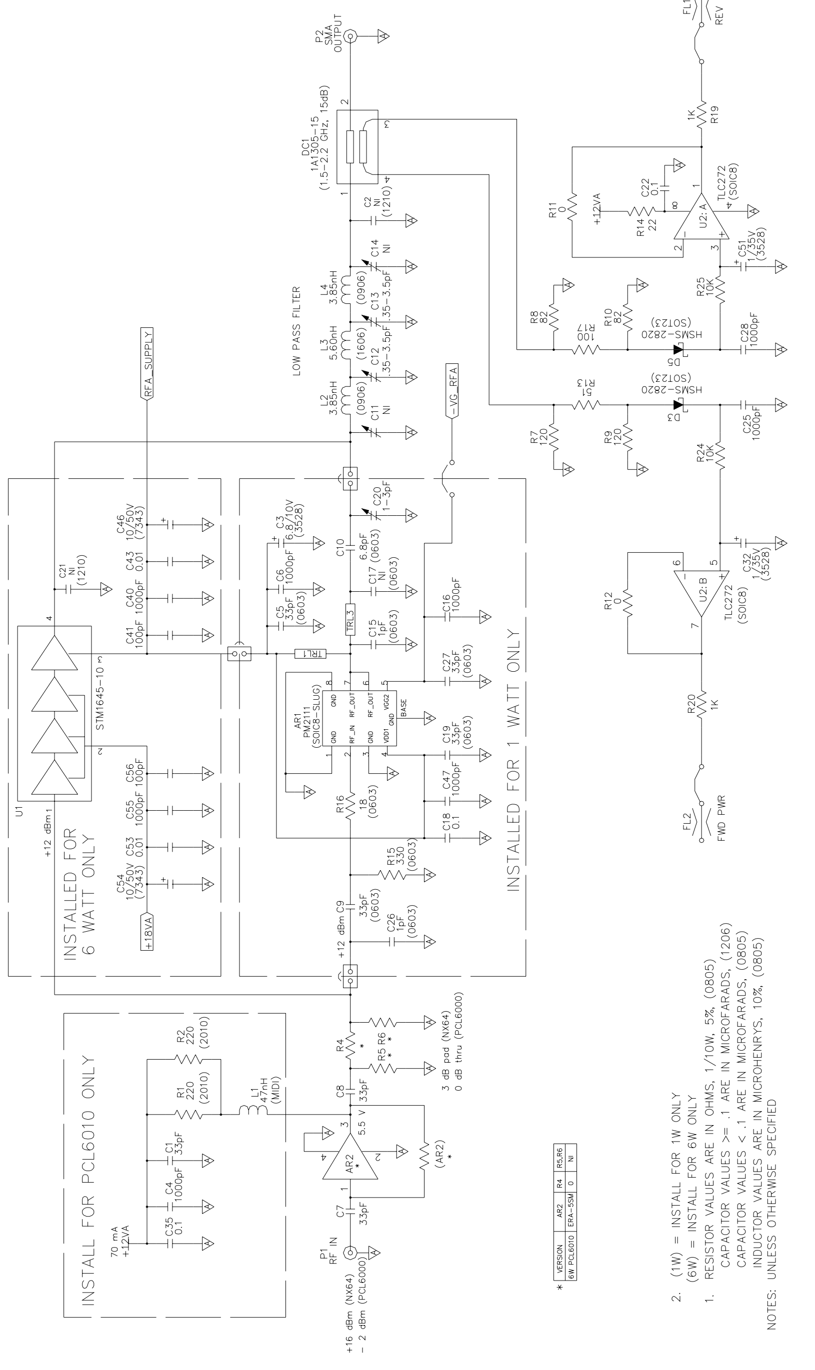
600-10227-01 REV H

Transmitter RF Module Schematic, p. 4 of 4

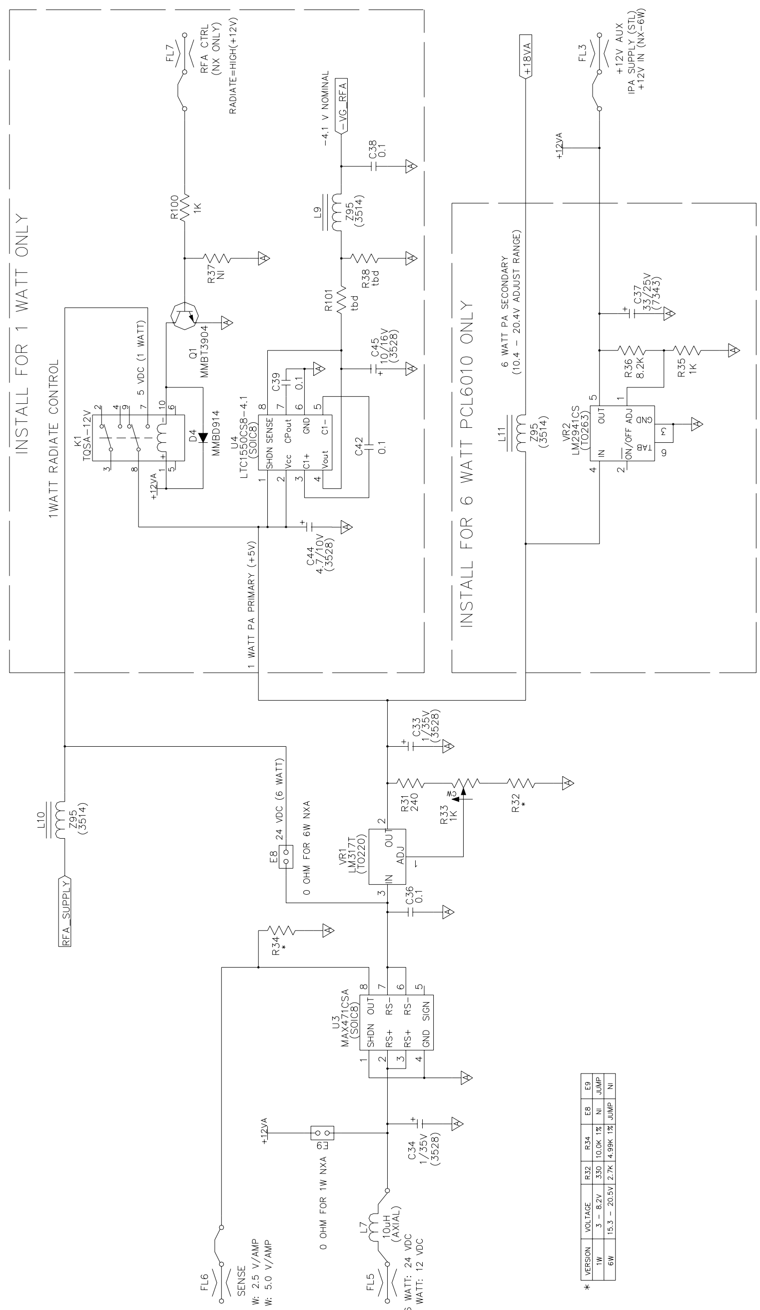


930-03462-01 Rev H

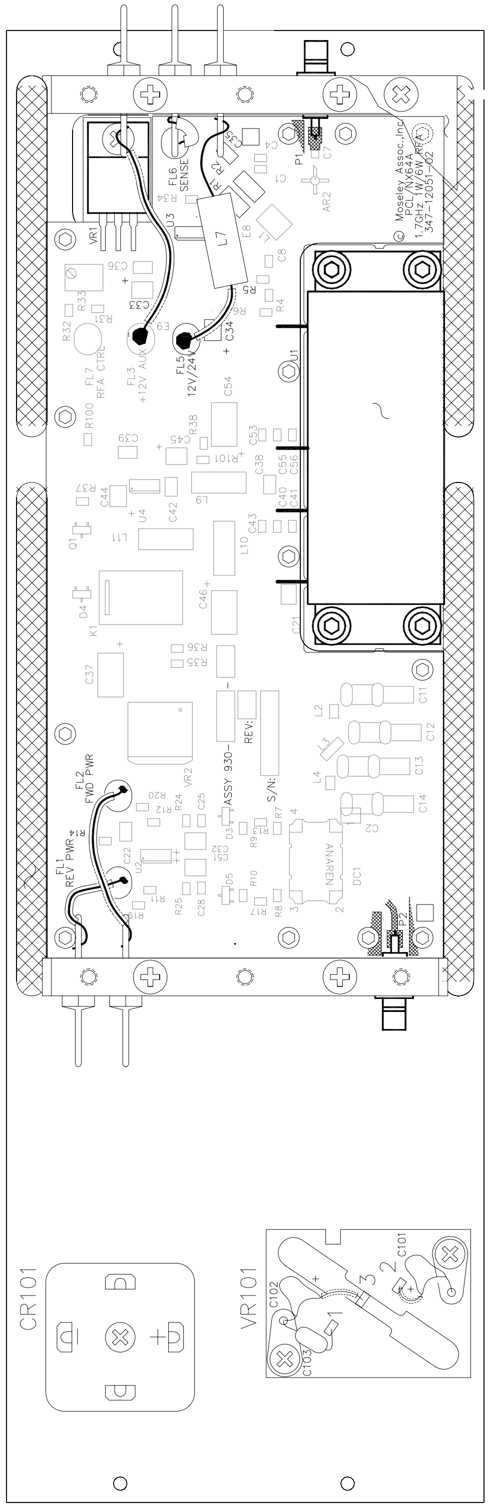
Transmitter RF Module Assembly



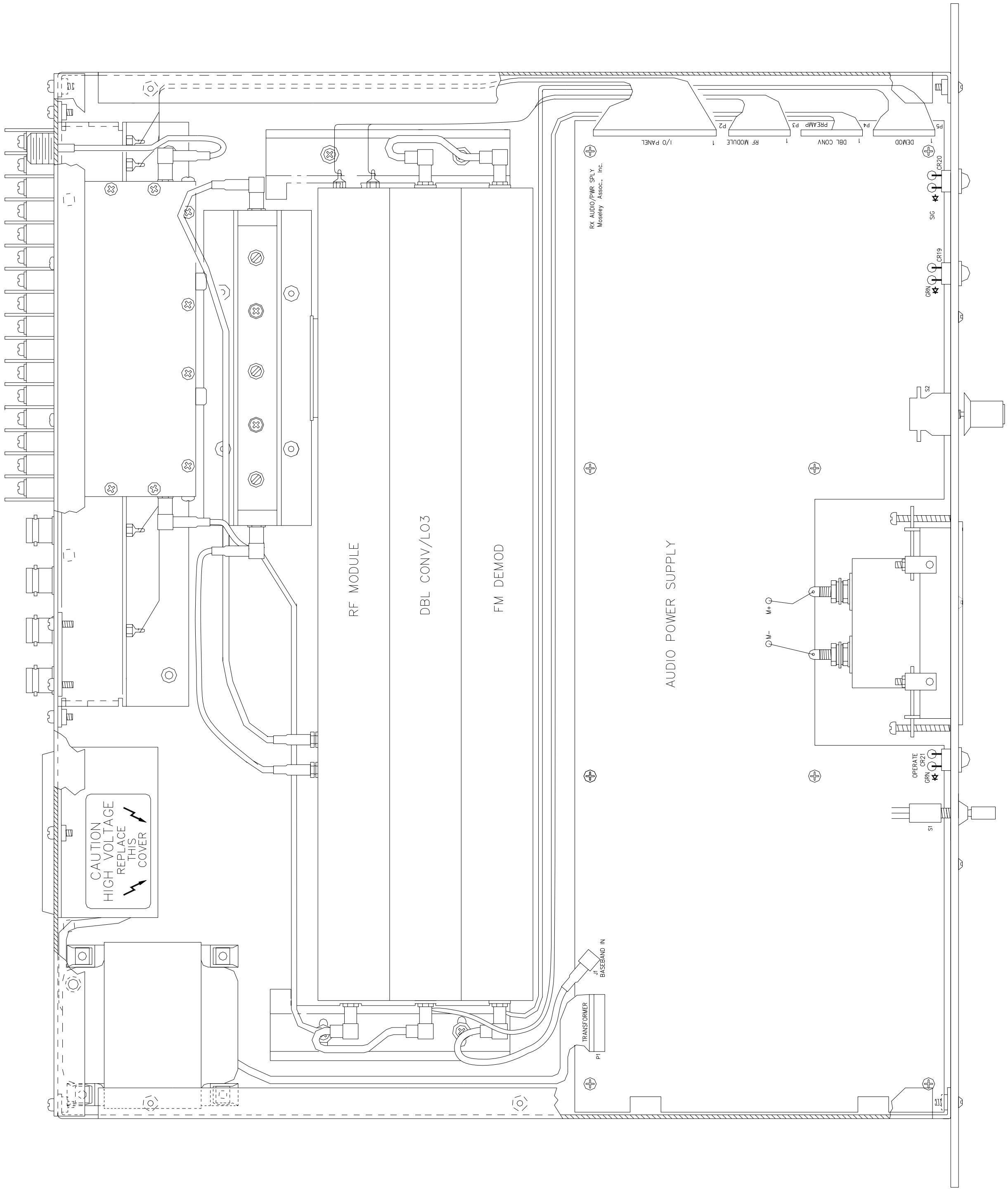
930-12053-02 Rev. B
RF Amplifier (1.7GHz, 6w) Schematic, p. 1 of 2



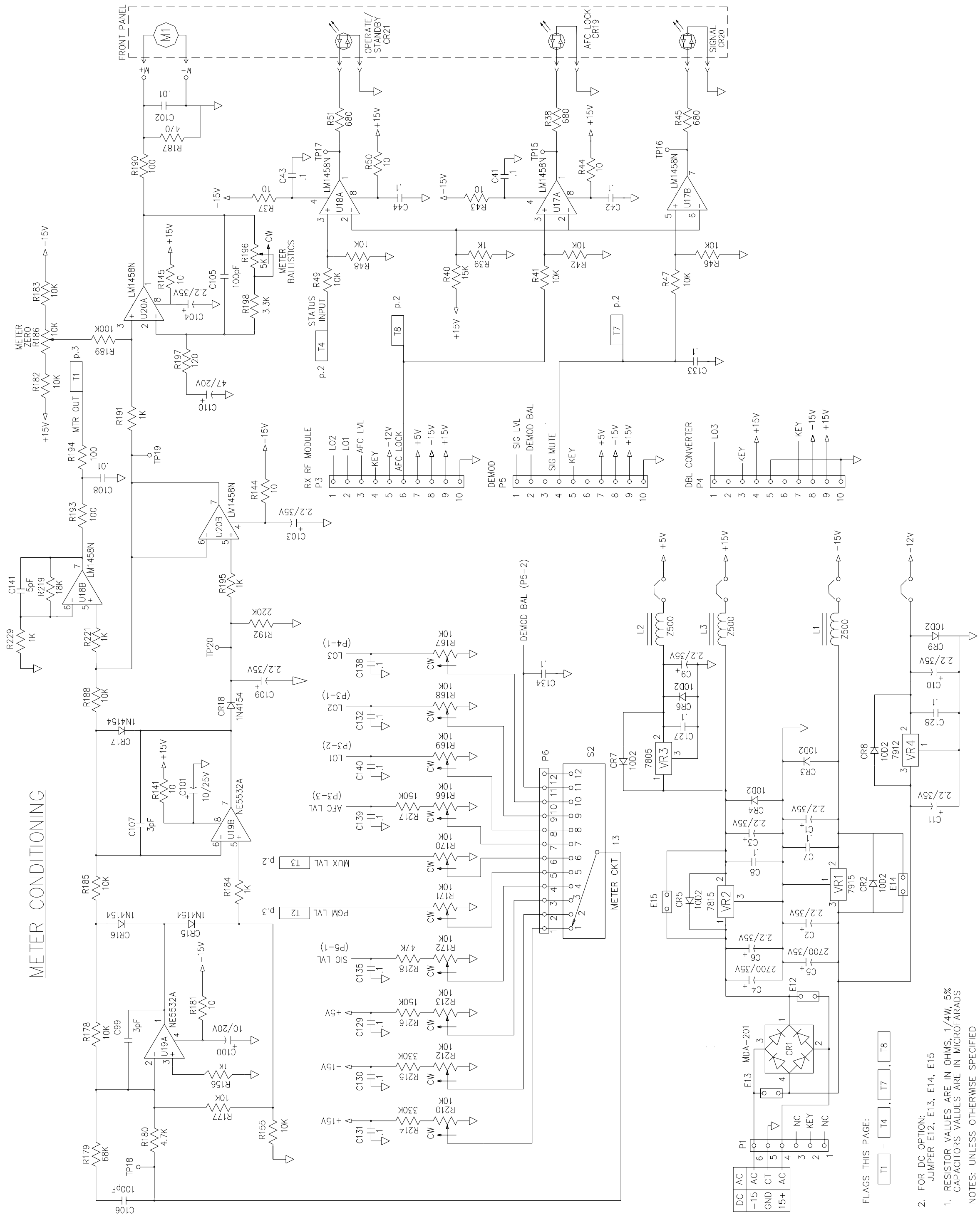
930-12053-02 Rev. B
RF Amplifier (1.7GHz, 6w) Schematic, p. 2 of 2



930-12052-02 REV B
RF Amplifier (1.7 GHz,6w) Assembly

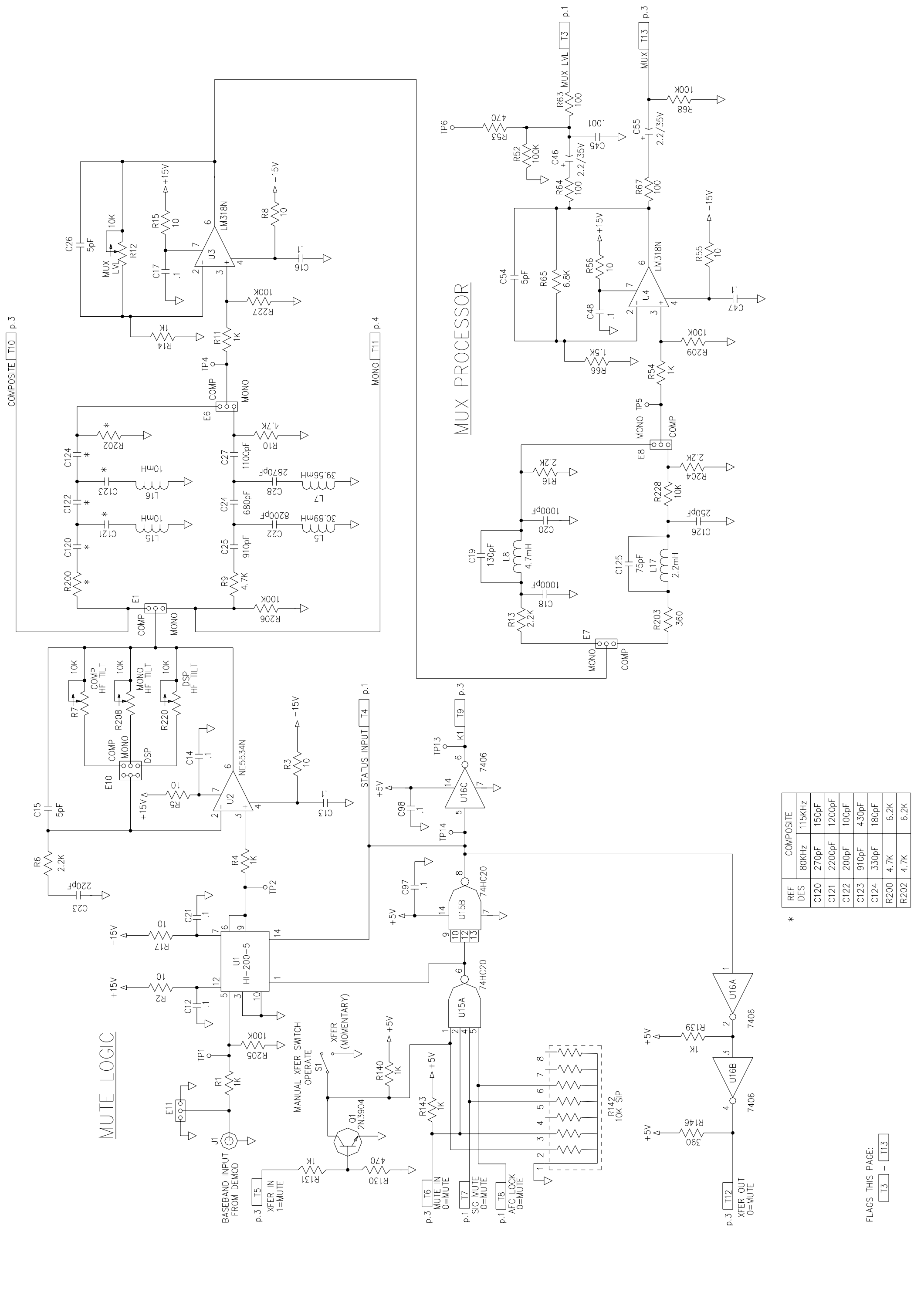


21B2927 Rev C
6030 Receiver Final Assembly



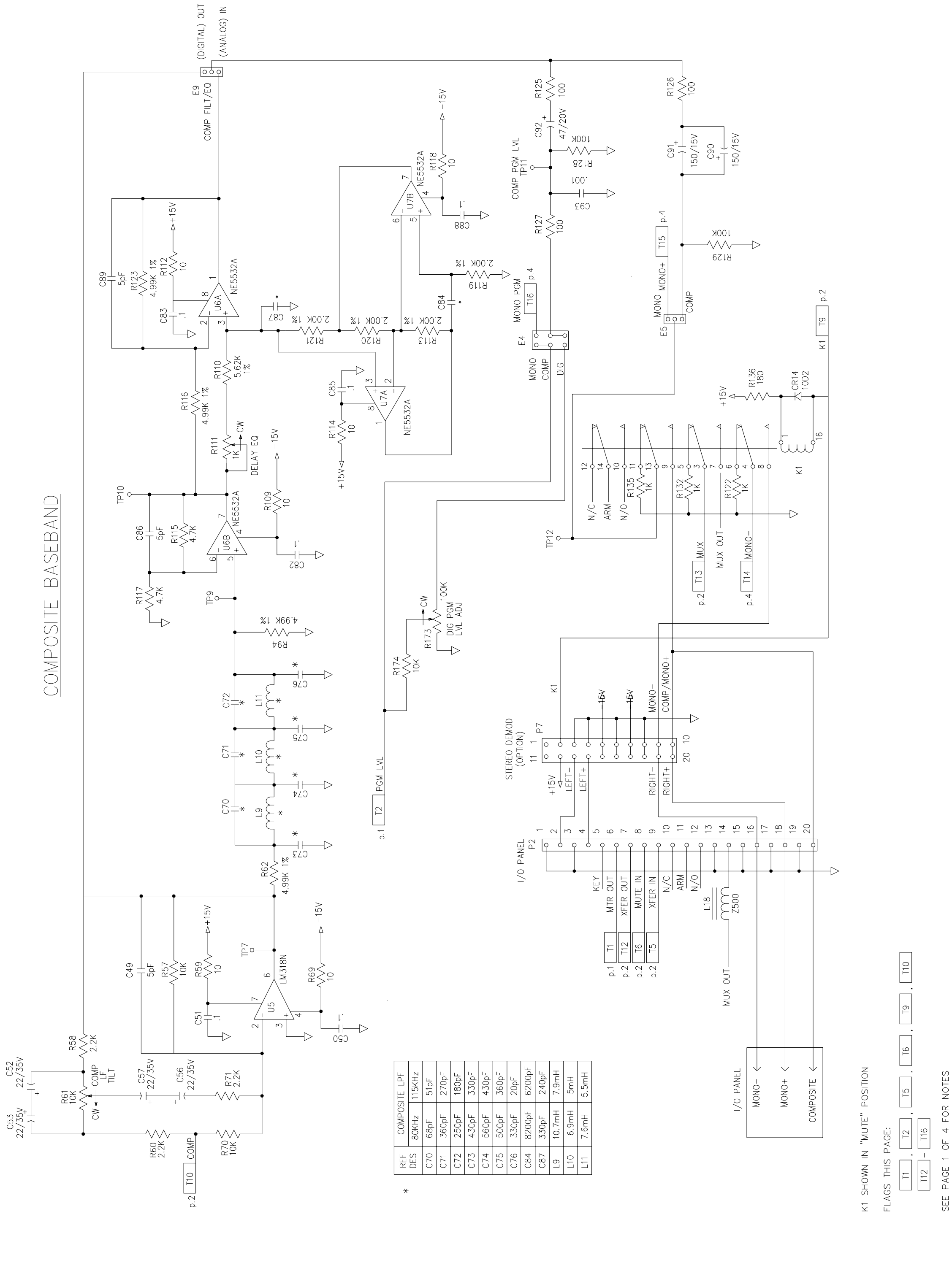
600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 1 of 4



600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 2 of 4

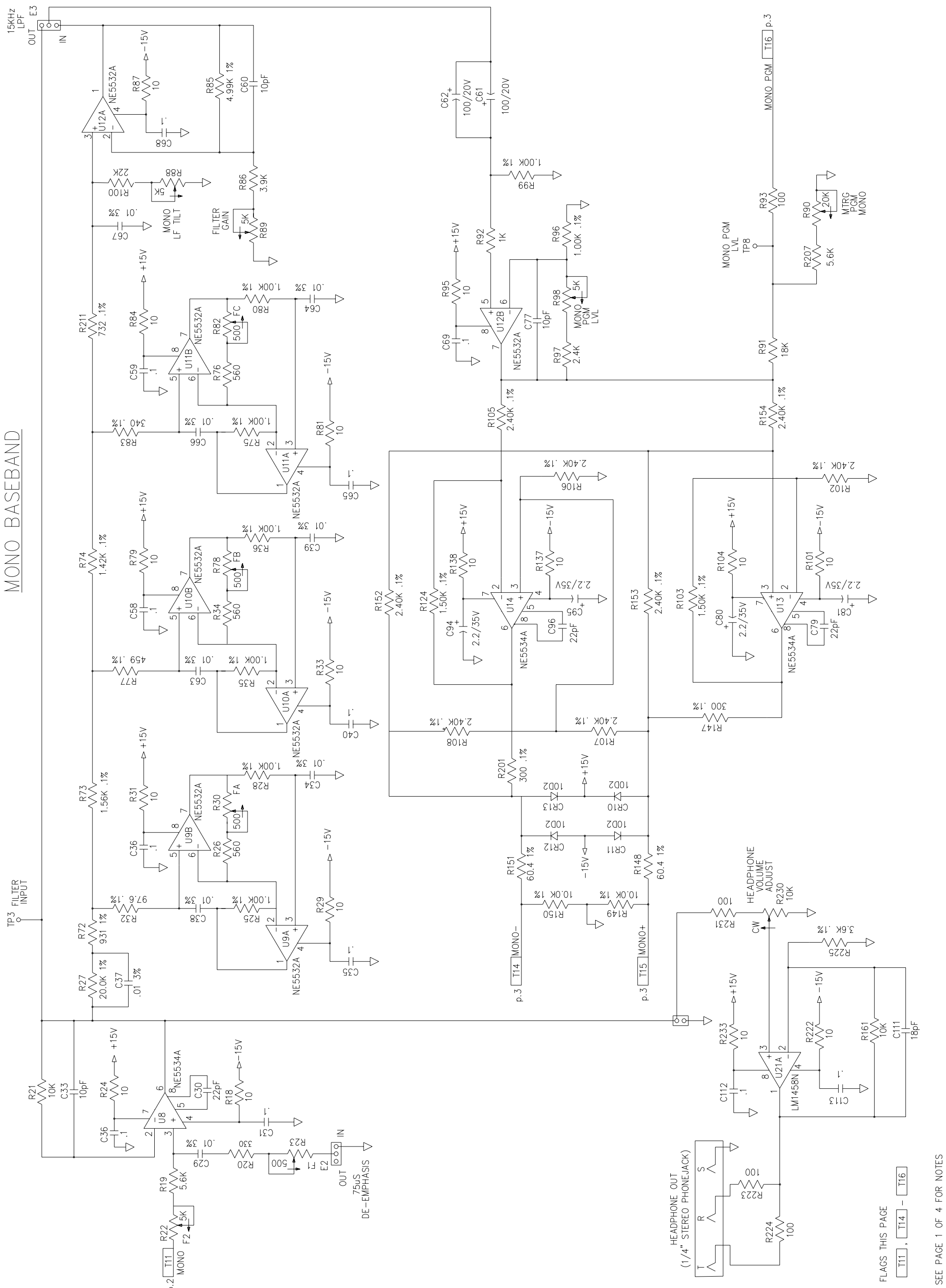


REF DES	COMPOSITE LPF 80KHz	115KHz
C70	68pF	51pF
C71	360pF	270pF
C72	250pF	180pF
C73	430pF	330pF
C74	560pF	430pF
C75	500pF	360pF
C76	330pF	20pF
C84	8200pF	6200pF
C87	330pF	240pF
L9	10.7mH	7.9mH
L10	6.9mH	5mH
L11	7.6mH	5.5mH

*

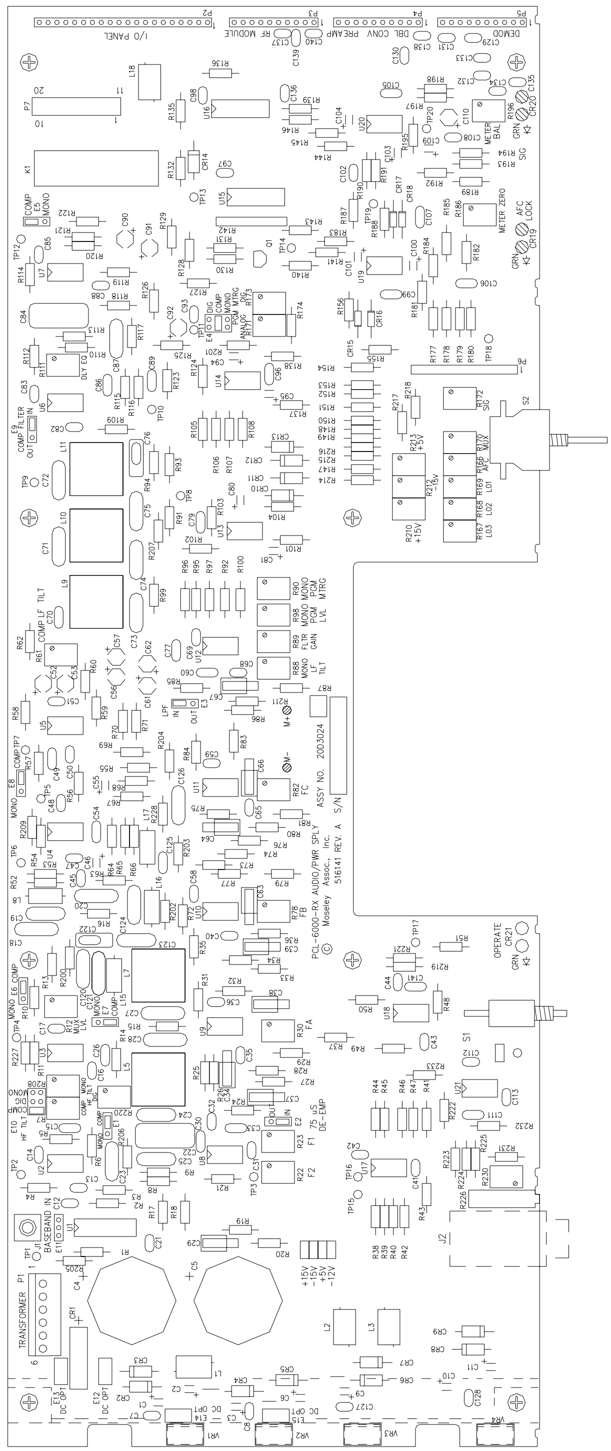
600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 3 of 4



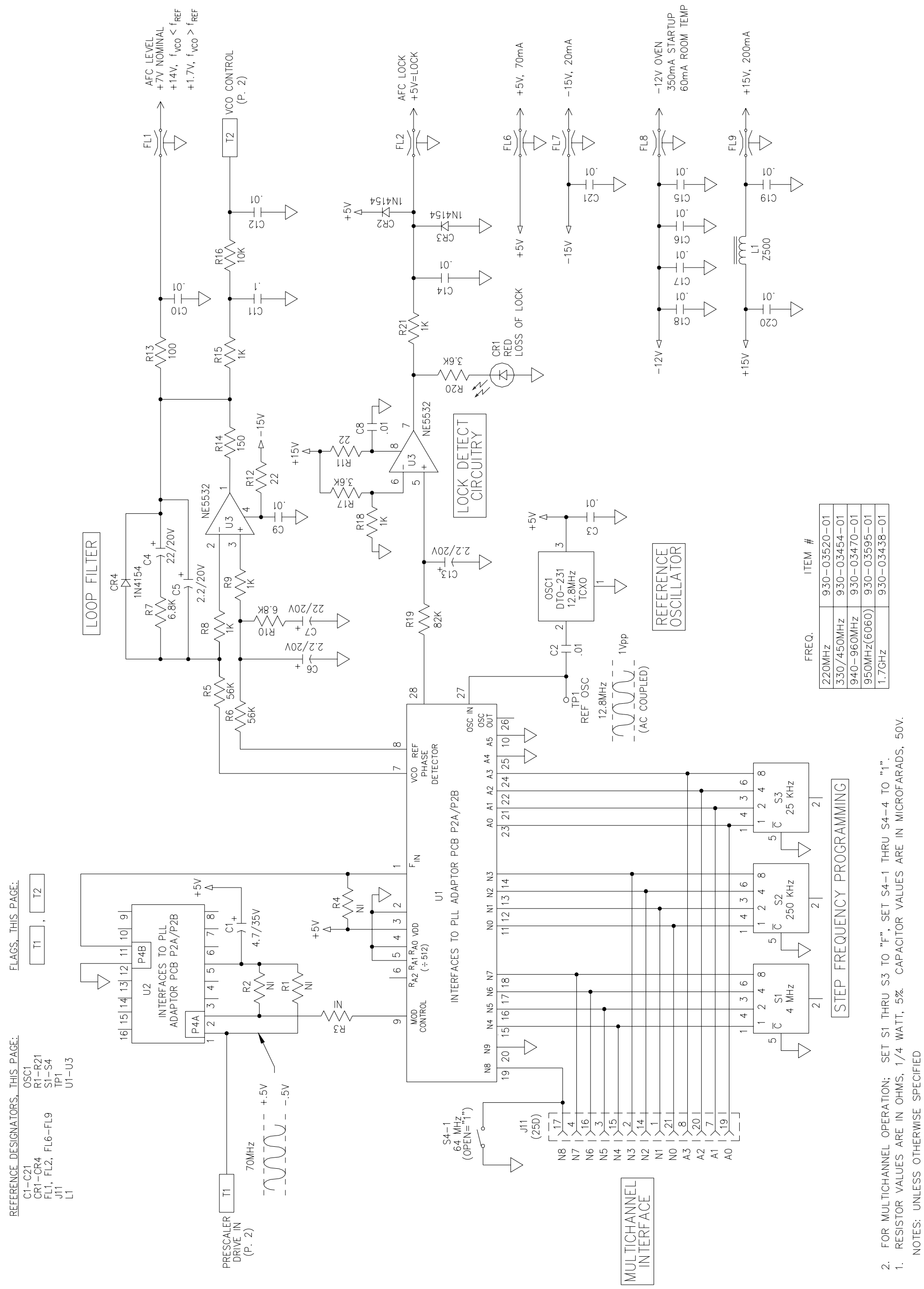
600-10710-01 Rev B

Receiver Audio/Power Supply Schematic, p. 4 of 4



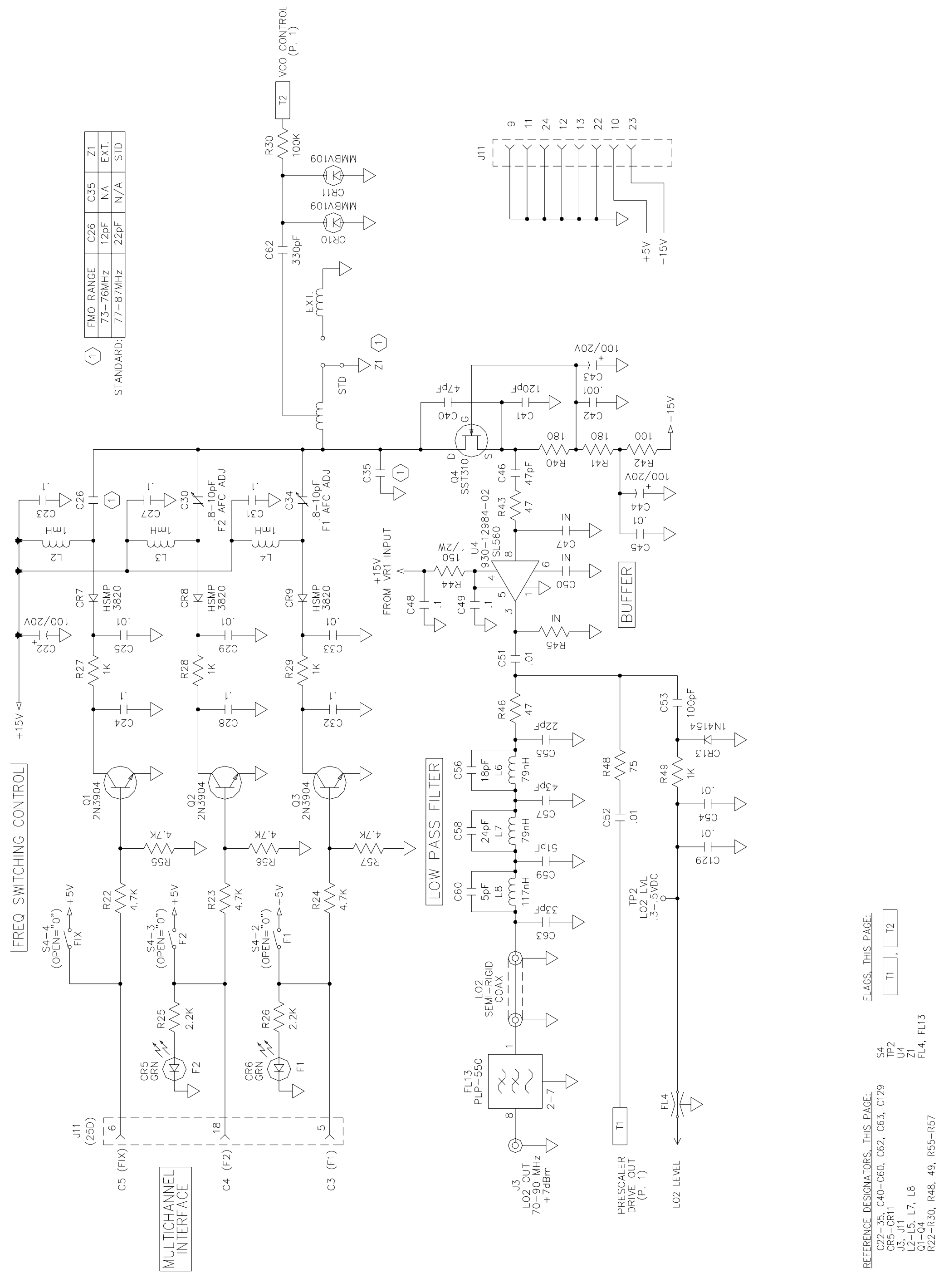
20B3024 Rev C

Receiver Audio/Power Supply Assembly



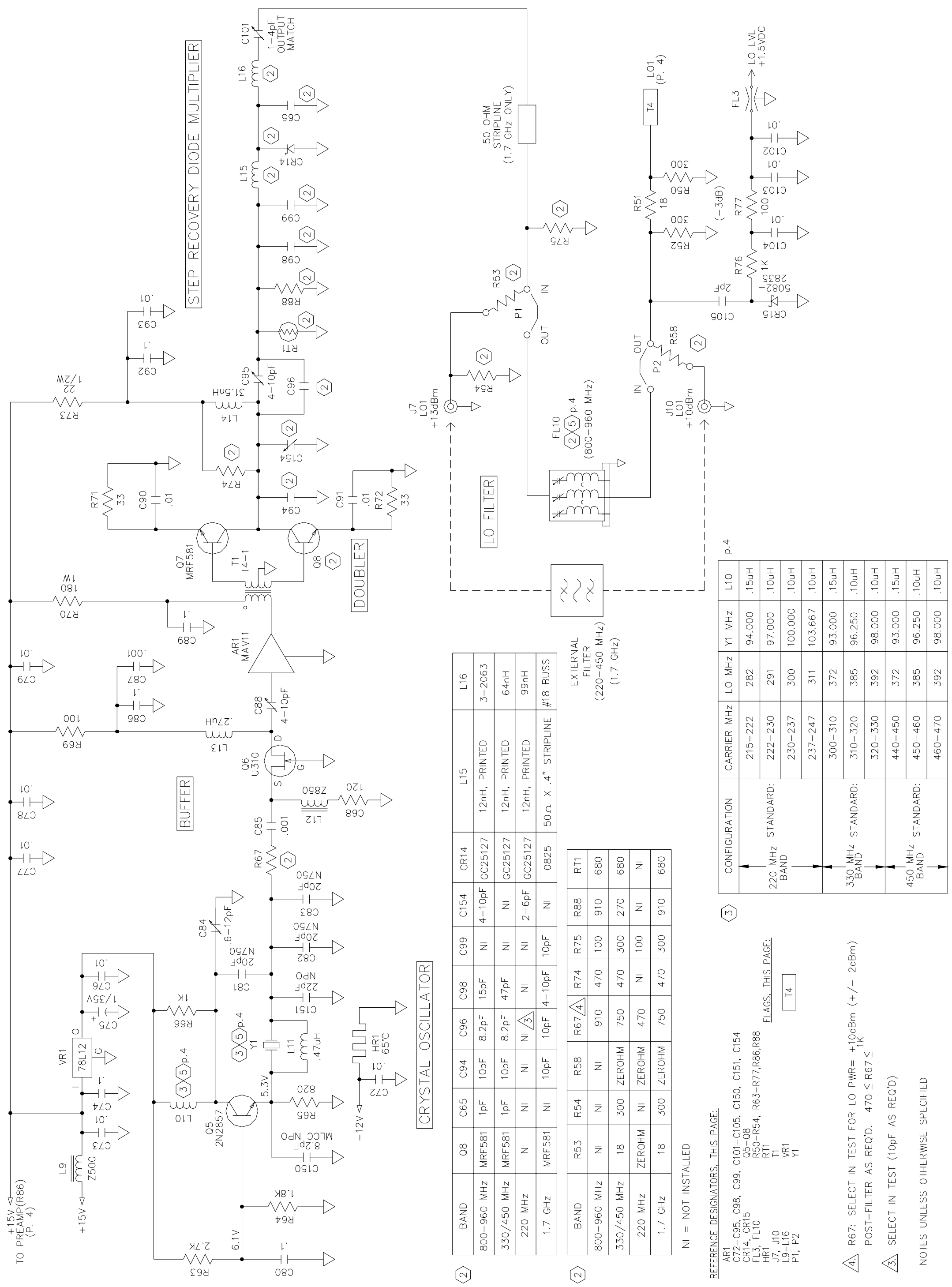
600-10228-01 Rev K

Receiver RF Module Schematic, p. 1 of 4



600-10228-01 Rev K

Receiver RF Module Schematic, p. 2 of 4



②

BAND	Q8	C65	C94	C96	C98	C99	C154	CR14	L15	L16
800-960 MHz	MRF581	1pF	10pF	8.2pF	15pF	NI	4-10pF	GC25127	12nH, PRINTED	3-2063
330/450 MHz	MRF581	1pF	10pF	8.2pF	47pF	NI	NI	GC25127	12nH, PRINTED	64nH
220 MHz	NI	NI	NI	NI ⚠3	NI	NI	2-6pF	GC25127	12nH, PRINTED	99nH
1.7 GHz	MRF581	NI	10pF	10pF	4-10pF	10pF	NI	0825	50Ω X .4" STRIPLINE	#18 BUSS

②

BAND	R53	R54	R58	R67 ⚠4	R74	R75	R88	RT1
800-960 MHz	NI	NI	NI	910	470	100	910	680
330/450 MHz	18	300	ZEROHM	750	470	300	270	680
220 MHz	ZEROHM	NI	ZEROHM	470	NI	100	NI	NI
1.7 GHz	18	300	ZEROHM	750	470	300	910	680

NI = NOT INSTALLED

③

CONFIGURATION		CARRIER MHz	LO MHz	Y1 MHz	L10
220 MHz BAND	STANDARD:	215-222	282	94.000	.15uH
		222-230	291	97.000	.10uH
		230-237	300	100.000	.10uH
		237-247	311	103.667	.10uH
330 MHz BAND	STANDARD:	300-310	372	93.000	.15uH
		310-320	385	96.250	.10uH
		320-330	392	98.000	.10uH
450 MHz BAND	STANDARD:	440-450	372	93.000	.15uH
		450-460	385	96.250	.10uH
		460-470	392	98.000	.10uH

p.4

REFERENCE DESIGNATORS, THIS PAGE:

AR1	
C72-C95, C98, C99, C101-C105, C150, C151, C154	
CR14, CR15	Q5-Q8
FL3, FL10	R50-R54, R63-R77,R86,R88
HR1	RT1
J7, J10	T1
L9-L16	VR1
P1, P2	Y1

FLAGS, THIS PAGE:

T4

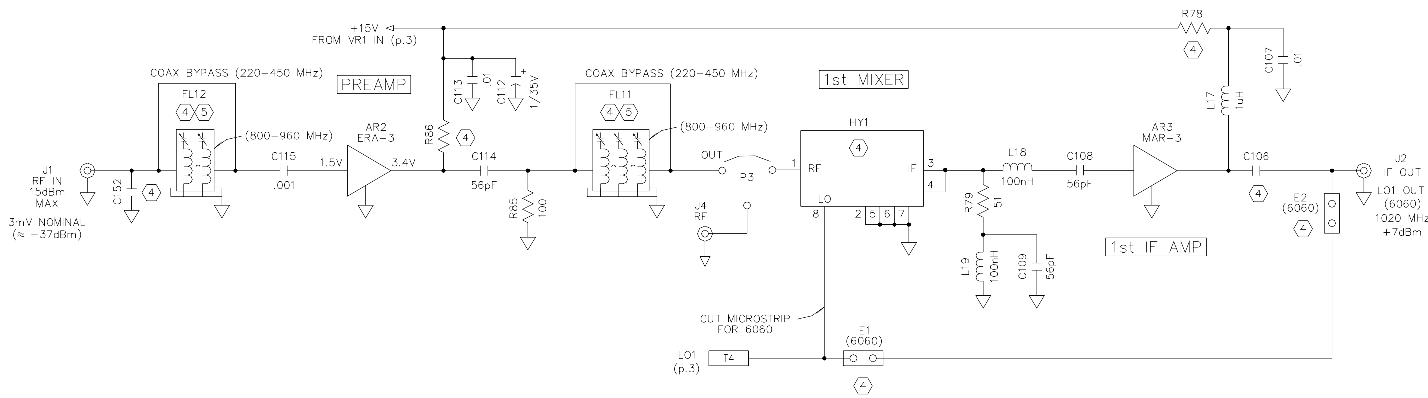
4. R67: SELECT IN TEST FOR LO PWR= +10dBm (+/- 2dBm) POST-FILTER AS REQ'D. 470 ≤ R67 ≤ 1K

3. SELECT IN TEST (10pF AS REQ'D)

NOTES UNLESS OTHERWISE SPECIFIED

600-10228-01 Rev K

Receiver RF Module Schematic, p. 3 of 4



				p.3	p.3	p.3	4	4
5 CONFIGURATION	CARRIER MHz	LO MHz	Y1 MHz	L10	FL10	FL11	FL12
STANDARD:	940–960	1020	102.000	.10uH	1271	1259	2737
	920–940	1000	100.000	.10uH	1271	1259	2737
	910–920	980	98.000	.10uH	1259	1259	2737
	900–910	980	98.000	.10uH	1259	1278	2737
950 MHz BAND	880–900	960	96.000	.10uH	1259	1278	2737
	860–880	940	94.000	.10uH	1259	1278	2737
	840–860	920	92.000	.10uH	1259	1328	2774
STANDARD:	840–860	920	92.000	.10uH	1259	1328	2774
	820–840	900	90.000	.10uH	1278	1328	2774
1.7 GHz BAND	800–820	880	88.000	.10uH	1278	1328	2774
	780–800	860	86.000	.15uH	—	—	—
	760–780	840	84.000	.15uH	—	—	—
	740–760	820	82.000	.15uH	—	—	—

4

BAND	HY1	R86	R78	C106	FL12	FL11	E1	E2	C152
6020/6030 950 MHz	SRA12	360	360	.01	(SEE CONFIG CHART) 5		NI	NI	1.0pF
6060 950 MHz	N/A	NI	NI	NI	NA		JUMPER	JUMPER	1.0pF
330/450 MHz	RFMX1	360	360	.01	COAX BYPASS		NI	NI	NI
220 MHz	RFMX1	360	360	.01	COAX BYPASS		NI	NI	NI
1.7GHz	RFMX1	360	360	.01	COAX BYPASS		NI	NI	NI

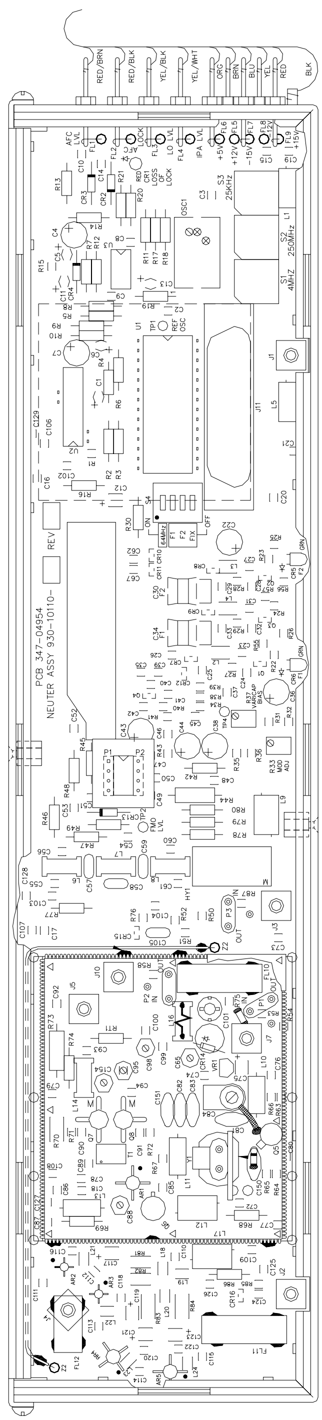
NI = NOT INSTALLED

REFERENCE DESIGNATORS, THIS PAGE:
AR2,AR3
C106–C109, C112–C115, C152
E1, E2
FL11, FL12
HY1
J1, J2, J4
L17–L19
P3
R78, R79, R85, R86
Z2

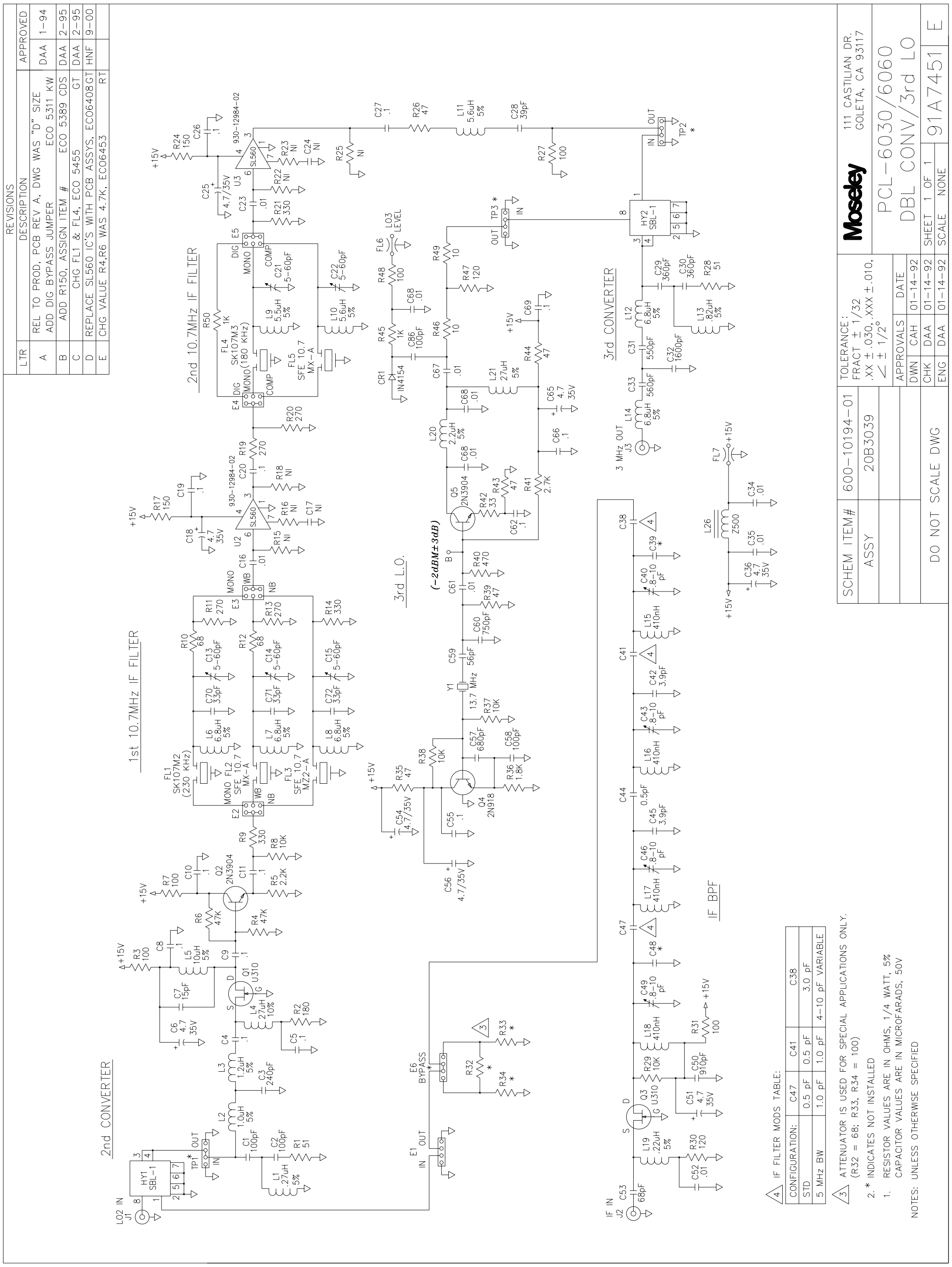
FLAGS, THIS PAGE:
T4

600-10228-01 Rev K

Receiver RF Module Schematic, p. 4 of 4

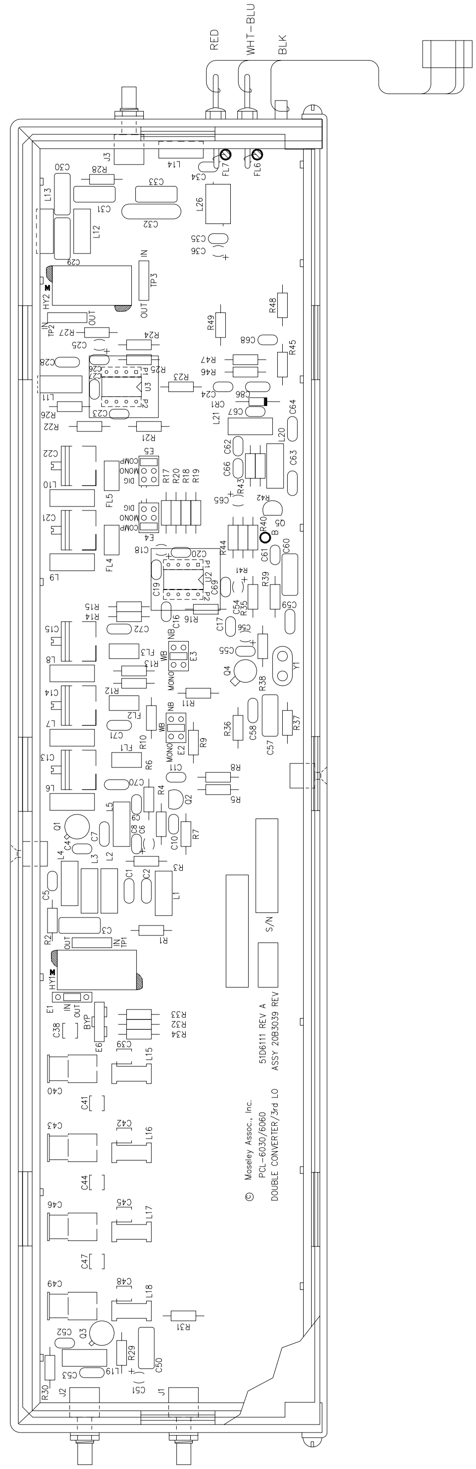


930-03546-01 Rev G
Receiver RF Module (6030) Assembly

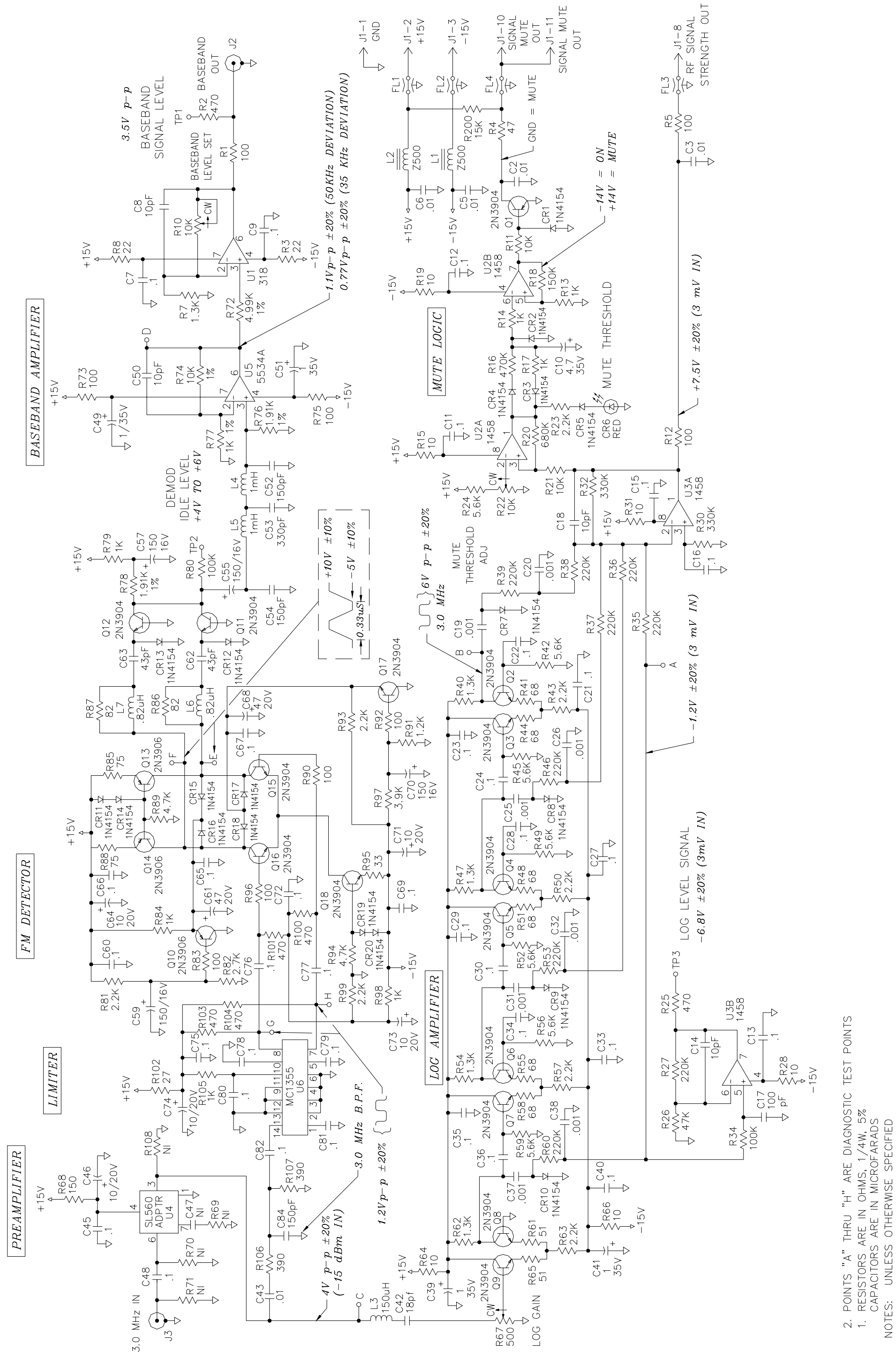


91B7451 Rev E

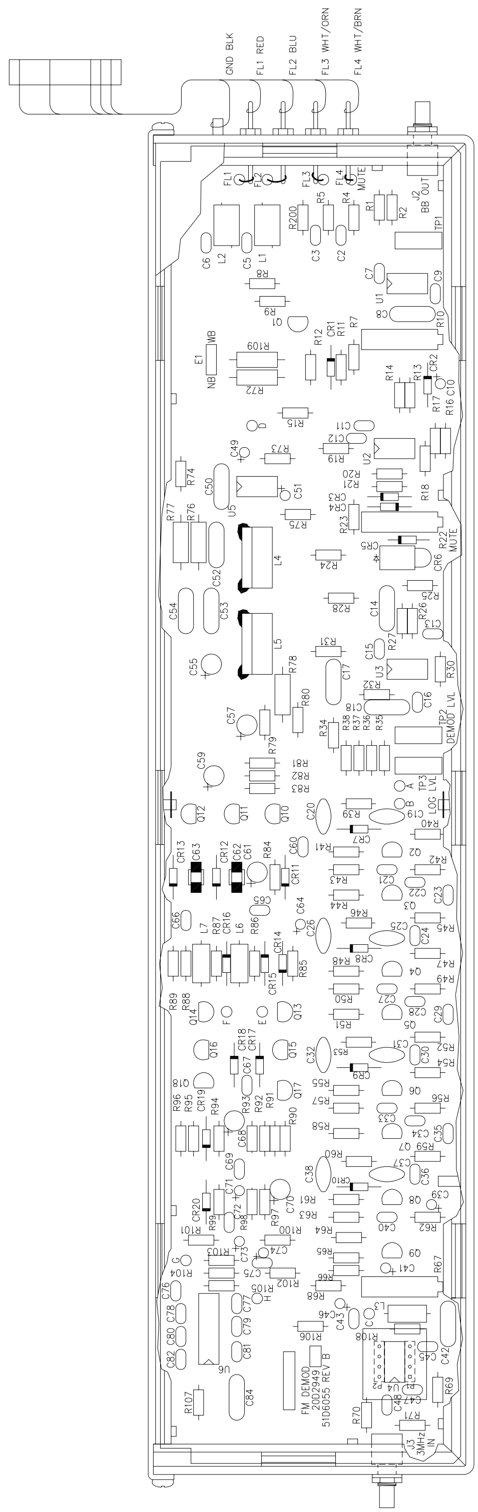
Double Converter/LO3 (6030) Schematic



20B3039 Rev E
Double Converter/LO3 (6030) Assembly



91B7387-Rev F
FM Demod (6030) Schematic



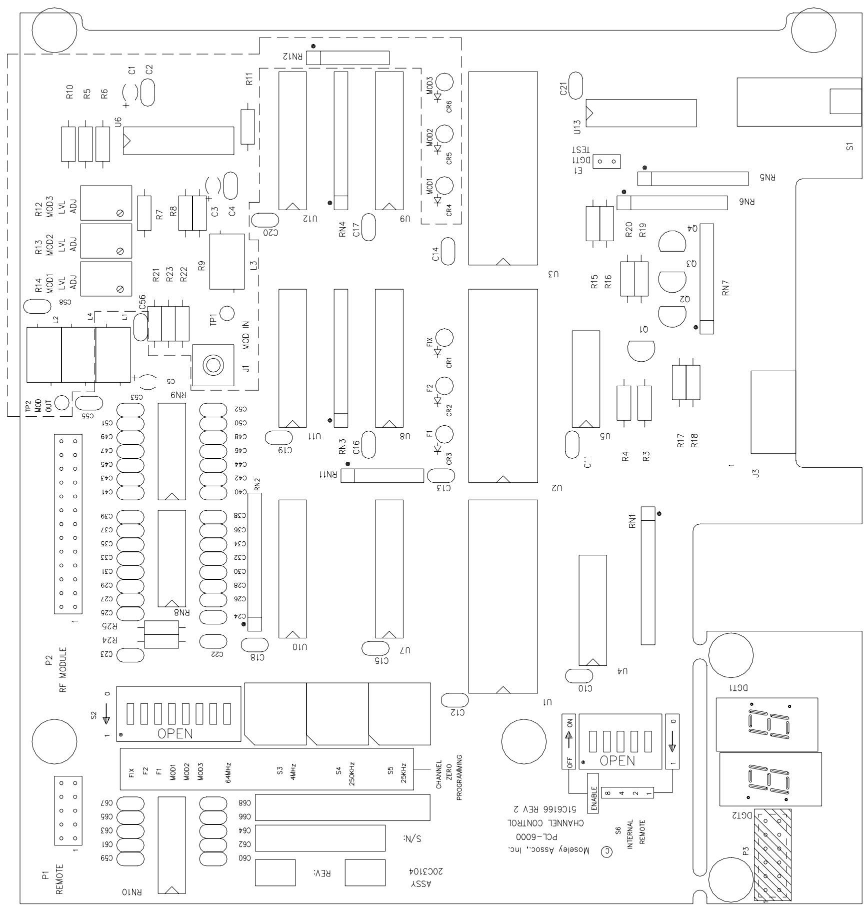
20B2949 Rev G
FM Demod (6030) Assembly

7.5 Multichannel Option

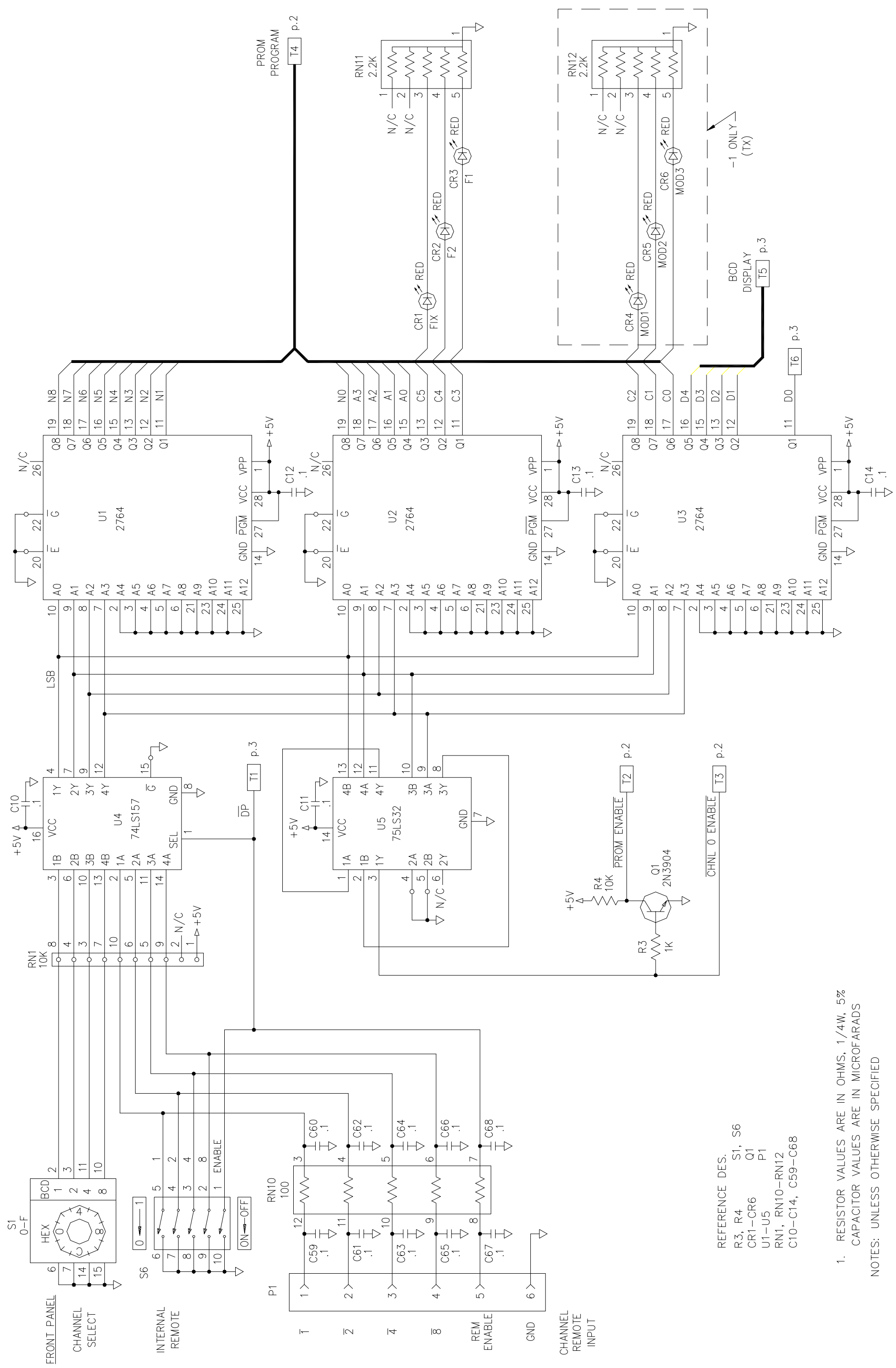
DESCRIPTION	ENG. DWG. No.	REV LEVEL
Channel Control Assembly	20C3104	A
Channel Control Schematic	917515	A
PCL6010 Multichannel Option	910-10121-02	C
PCL6020 Multichannel Option	910-08614-01	B
PCL6030 Multichannel Option	910-08796-01	B

NOTICE:

This section contains schematic and assembly drawings referred to in Sections 1 and 4. For information on individual drawings refer to Section 1 under "System Description" and/or Section 4 under "Module Description".

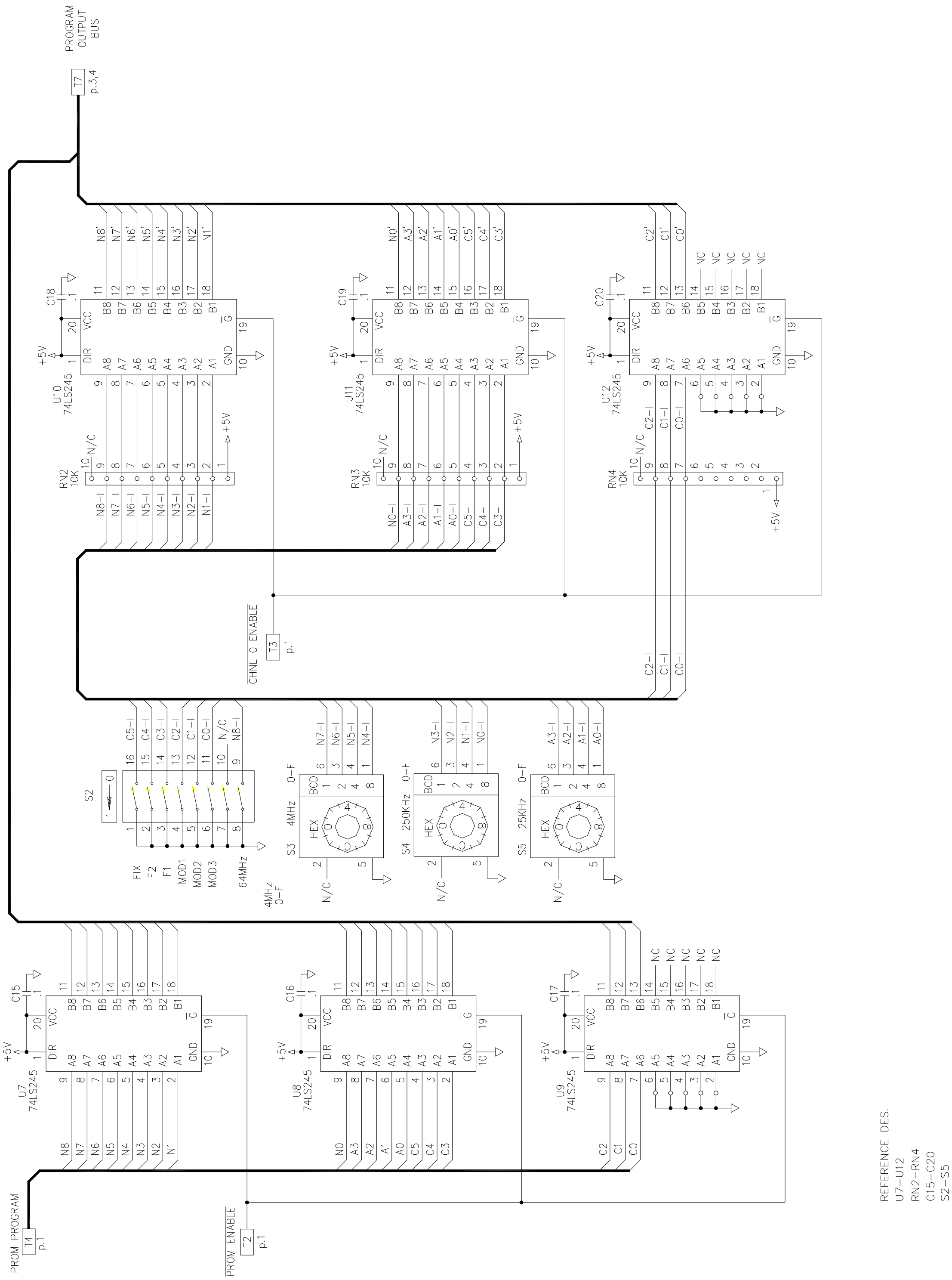


20C3104 Rev A
Channel Control Assembly



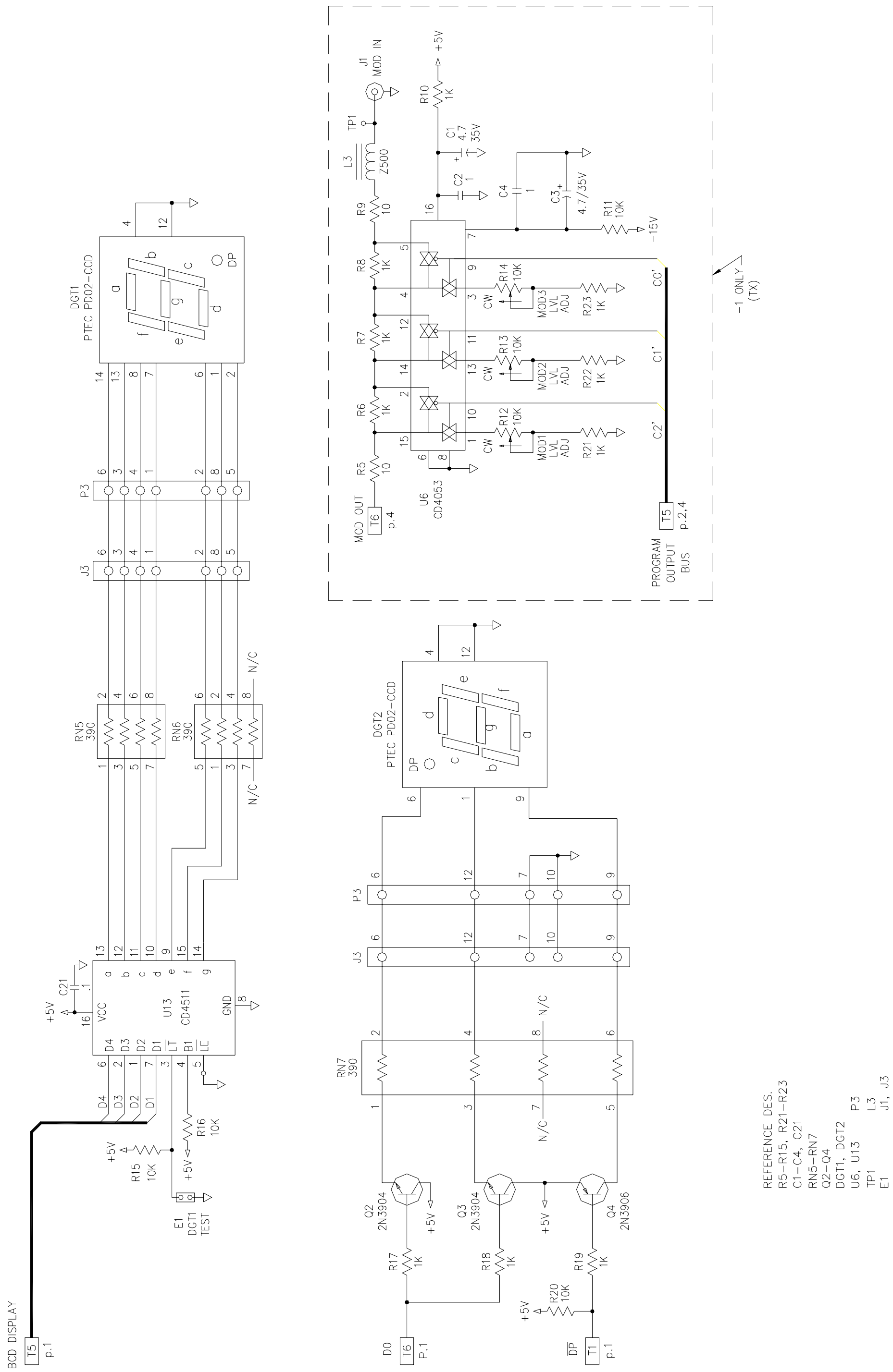
917515 Rev A

Channel Control Schematic, 1 of 4



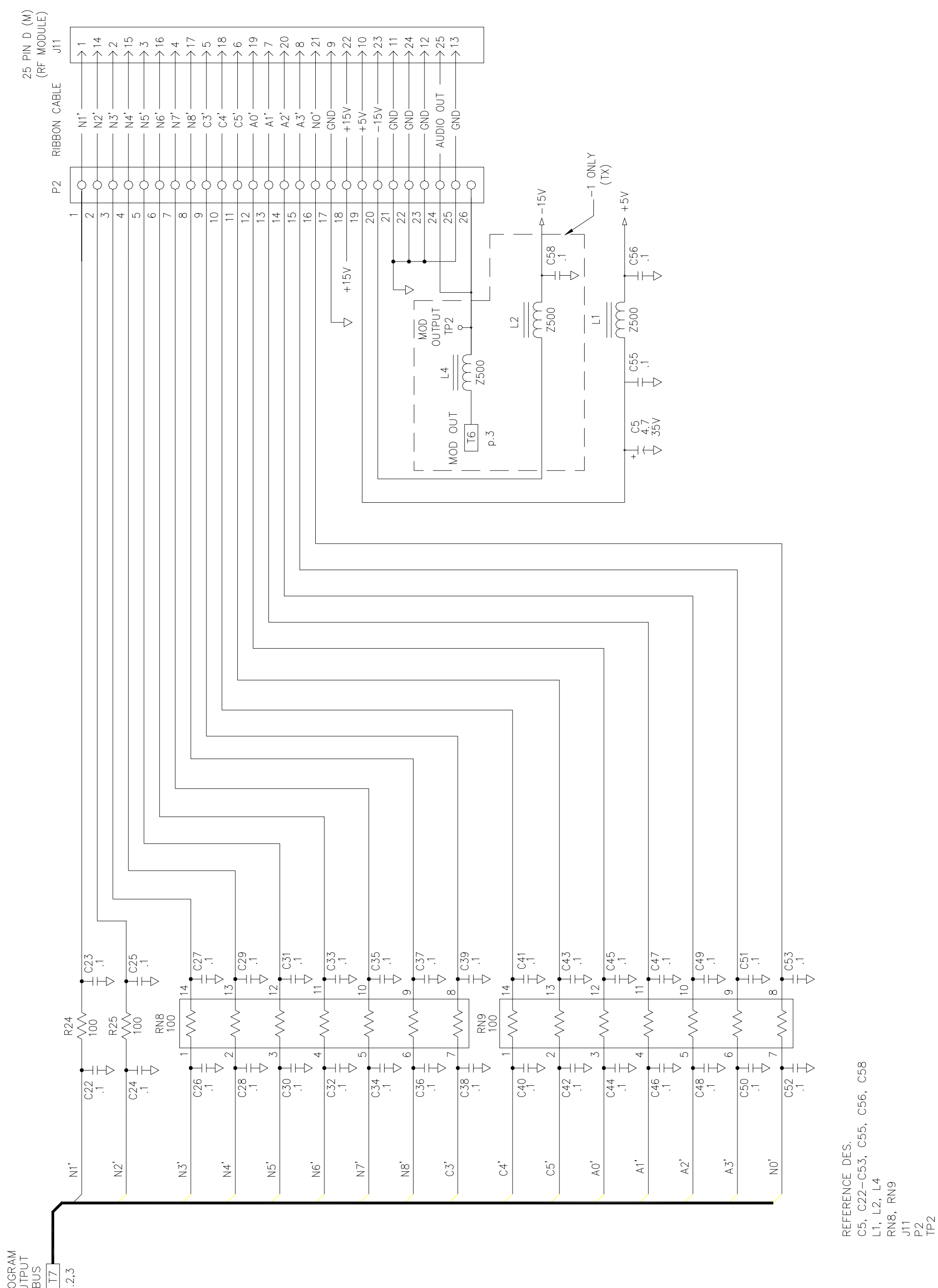
917515 Rev A

Channel Control Schematic, 2 of 4



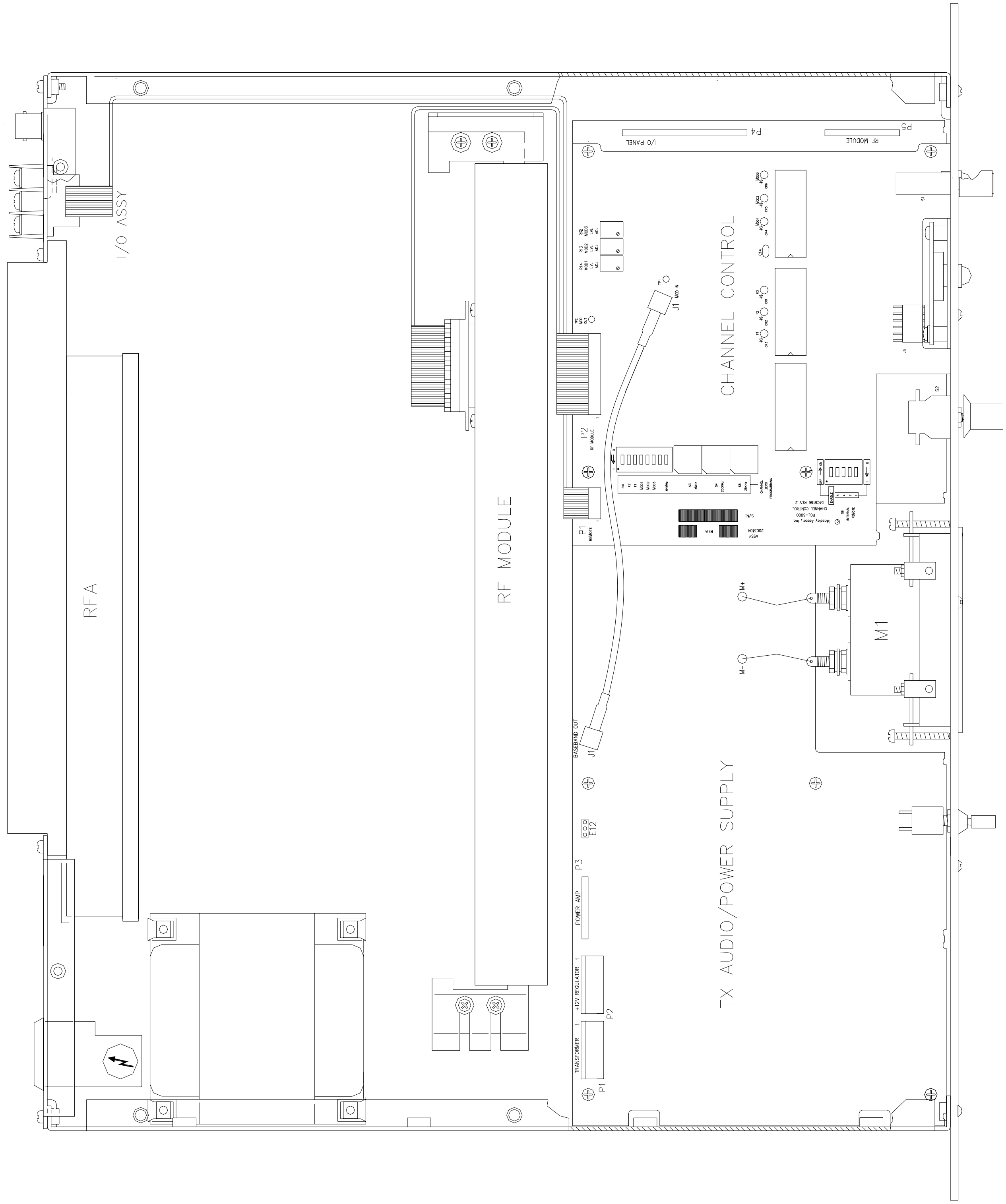
917515 Rev A

Channel Control Schematic, 3 of 4

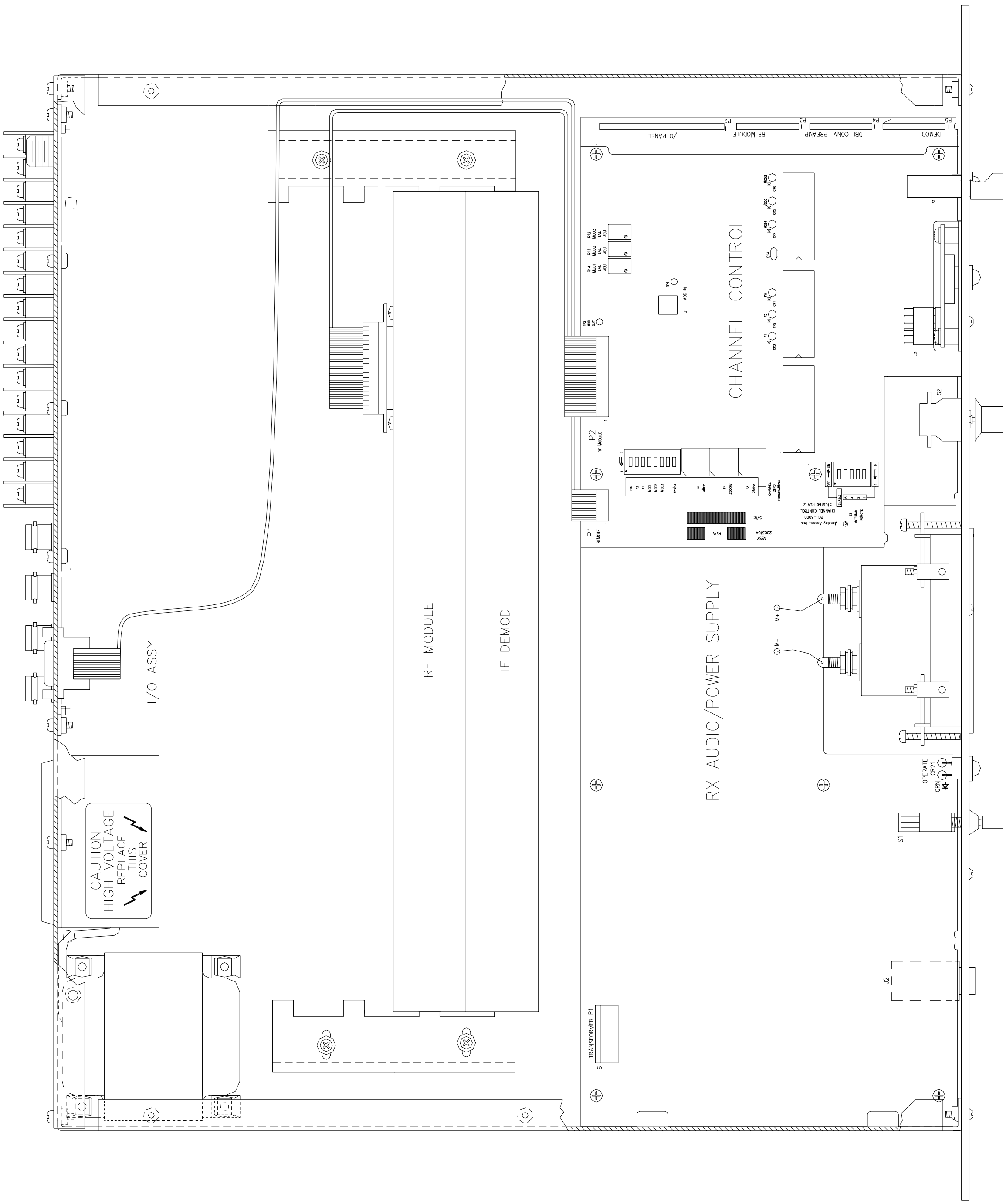


917515 Rev A

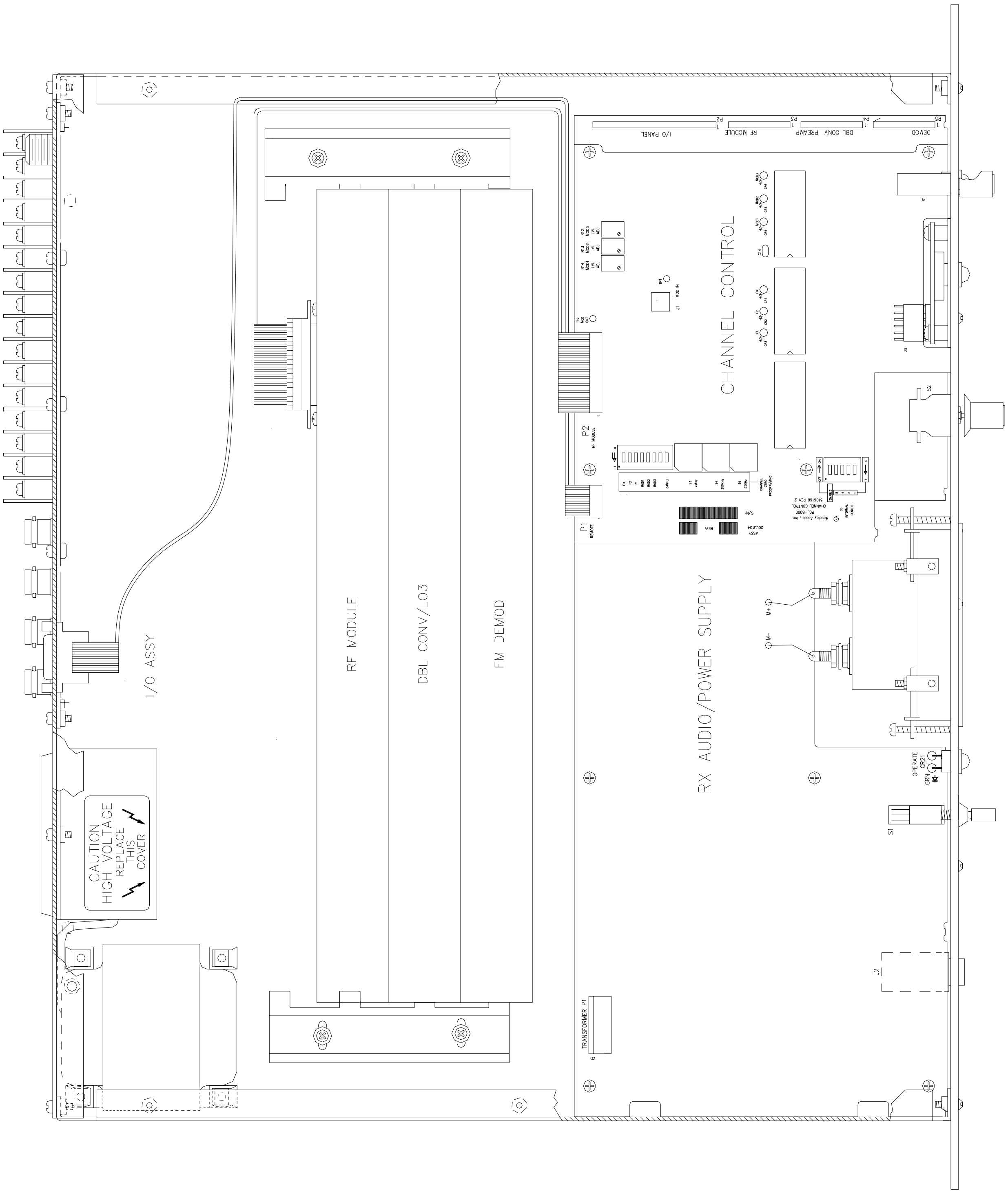
Channel Control Schematic, 4 of 4



910-10121-02 Rev C
PCL6010 Multichannel Option



910-08614-01 Rev B
PCL 6020 Multichannel Option



910-08796-01 Rev B
PCL 6030 Multichannel Option